Factors Affecting Bidding and Markup Decisions in Saudi Arabia

by

Nader Husni Abdul-Hadi

A Thesis Presented to the

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This thesis, written by NADER HUSNI ABDUL-HADI under the direction of his Thesis Advisor and approved by his Thesis Committee, has been presented to and accepted by the Dean of the College of Graduate Studies, in partial fulfillment of the requirements for the degree of MASTER OF SCIENCE in CONSTRUCTION ENGINEERING AND MANAGEMENT.

Thesis Committee

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Date

I dedicate this work to my beloved parents.

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Special thanks go to my beloved parents, my brothers and sisters, my wife, and my friends.

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التخـــــصص : هندســة و إدارة التشييد

تاريخ الشهــادة : ٢٩ جمادى الآخرة ١٤١١ هجرى.

في صناعة التشييد ، يواجه المقاول قرارين صعبين و حرجين. القرار الأول يتعلق بدخول المناقصه أو عدمه. إذا قرر المقاول الدخول في المناقصة فيجب عليه أن يتخذ القرار الثاني و هو نسبة الربح التي سيضيفها إلى قيمة المشروع حتى يكون صاحب أقل عطاء و في نفس الوقت يحقق ربحاً معقولاً. لذا كان الهدف الرئيسي لهذه الدراسة هو البحث عن العوامل المؤثرة على هذين القرارين ، و معرفة أهميتها بالنسبه للمقاولين العاملين في المملكة العربية السعودية.

و قد تم التعرف على الكثير من العوامل المهمة، و تم تصنيفها إلى خمس مجموعات هي: خواص المشروع ، وثائق المشروع ، خواص الشركه ، وضع الدخول في المناقصات ، و الوضع الاقتصادي. و قد تم تقدير أهمية هذه العوامل بواسطة المقاولين الذين أبدوا آراءهم من خلال الاستبيان الذي أرسل إليهم. و قد حللت المعلومات إحصائياً ببرنامج ساس (SAS).

و تبين من خلال البحث أن المنافسه و الربح ليست أهم العوامل ، و أن السيولة المالية للمشروع و توفر المال المطلوب هما أهم عاملين لقرار الدخول في المناقصات، و أن قيمة العقد و توفر المال المطلوب هما أهم عاملين لقرار نسبة الربح. تبين كذلك أن أهمية العوامل تختلف باختلاف حجم المقاول. و قد تم تصنيف المقاولين إلى "جيدين" و "غير جيدين" و درست آراءهم حول العوامل المختلفه و وجد أن المقاولين "الجيدين" يختلفون عن "غير الجيدين".

لمساعدة المقاولين في اتخاذ القرارات الصحيحة تمت التوصية بالتركيز على بعض العوامل ذات الأهمية القصوى لقرارى الدخول في المناقصة و نسبة الربح المطلوبه.

درجة الماجستير في العلوم
جامعة الملك فهد للبترول و المعادن
الظهران / المملكة العربية السعودية.

THESIS ABSTRACT

FULL NAME OF STUDENT	:	Nader Husni Hamed Abdul-Hadi
TITLE OF STUDY	:	Factors Affecting Bidding and Markup Decisions in Saudi Arabia
MAJOR FIELD	:	Construction Engineering and Management
DATE OF DEGREE	:	January 15, 1991

In the construction industry, the contractor is faced with two critical decisions. He has to decide whether to bid a project or not. If he decides to bid, the contractor must decide on the proper markup size in order to be the lowest bidder and realize a reasonable profit. The main objective of this study is to investigate the factors underlying both decisions, and to study their relative importance to contractors operating in Saudi Arabia.

Many factors were identified as important. They were grouped into five categories: project characteristics, project documents, company characteristics, the bidding situation, and the economic situation. The importance of these factors was assessed by contractors via a mailed questionnaire. Descriptive statistics, importance index, and discriminant analysis were used to analyze the data.

The results show that factors such as competition and profitability are not the most important factors. Project cash flow and availability of required cash are the top two factors in the decision to bid, while size of contract and availability of required cash are the top two factors in the markup decision. The importance of the different factors changes as the size of the contractor changes. Contractors were classified into "Good" and "Bad" bidders; their attitude towards the different factors was studied. Good bidders were found to be different from bad bidders.

In order for contractors to enhance their chances of making the right decisions, they are advised to pay great attention to the factors affecting their bidding and markup decisions.

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Chapter 1

INTRODUCTION

The construction industry is unique among other industries. Its risky and uncertain environment makes it a special case. It can be said that there is nothing certain in the construction industry. Labor wages are increasing all the time. Labor productivity also changes depending on many variables such as weather, skill, motivation,etc. Some of these variables cannot be known, or even if known, cannot be controlled. Material prices are also changing, and their availability when needed is not always known.

The risks of this industry are divided between the contractor, the owner, the architect/engineer, and other parties. Projects are usually awarded on a competitive or negotiated basis. It is competitive bidding that transfers all the risk from the owner to the contractor. In a competitive bidding situation, the contract is usually awarded to the lowest bidder. When projects are awarded on a competitive basis the contractor is supposed to estimate the cost of the project. It is the contractor's responsibility to take into account all factors affecting the project cost. This task, as said by many contractors, is a matter of accident than design.

The success or failure of a contractor may be measured on profit basis. It is, of course, known that the main objective for any contractor is to make a profit. However, in order to accomplish this objective, other objectives can be set. These are :(17)

1. "Maximize the expected profit.
   (Expected profit = the probability of winning * the potential profit).
2. Recover a certain percentage of investment.
3. Minimize expected losses.
4. Win the contract, even at a loss, in order to keep production going."

If the profitability of a contractor is the measure of his success, then how can he maximize his profit? A contractor can increase his profit margin but by doing this the contractor is minimizing his chances of being the lowest bidder. On the other extreme, the contractor can minimize his profit margin so that his chances of being the lowest bidder are maximized ; however, this situation may and will cause loss which is not the objective of the contractor.

The usual practice by contractors is to estimate the cost of the project then add an allowance for overhead, contingencies, and profit. This allowance is called the markup. The amount that a contractor adds as a markup usually determines the lowest bidder on a project. Consequently, the contractor should make a trade-off between the markup and the probability of winning the contract, and being the lowest bidder.

The question to be asked is, what determines the markup a contractor should add? If a contractor can determine and identify all the factors that affect his markup, then the chances of applying the right amount of markup to the right project will be much improved and the contractor's bidding situation will be also enhanced.

1.1 Significance of the Study

During the period from 1973-1982 there was very high demand for construction in Saudi Arabia (3,4). Money was not the main issue since the government did all it could to help rapid development. This environment did not encourage the use of bidding strategies. Competition was very limited, demand was high, and contractors were operating at full capacity realizing a very large profit margin. Nowadays the situation is the opposite. The drop in oil prices after 1982 affected the whole economic situation in Saudi Arabia but the recession was very clear in the construction industry (3,4). Construction demand decreased until it became very low. The economic situation did not improve much, competition became very high, and the profit margin substantially decreased. In this tough environment only the strong will survive. Contractors in such an environment are forced to develop a strategy by which they can optimize all their available resources. They must use more rational ways of understanding the current market situation to improve their competitive situation. They need to use more rational ways of deciding whether to or not to bid, and to determine their markups. This way of thinking is essential for all contractors including those operating in the Saudi environment because the awarding system depends basically on the lowest bidder criterion.

This thesis is an attempt to study the different factors that affect the decision to bid or not. Also the factors affecting the amount of markup a contractor adds to his estimated cost are stud-

ied. If the most important factors can be identified and their effect is understood, a more objective and rational way of determining the markup may be introduced.

This thesis may be used later to design an expert system to help contractors in their decisions.

1.2 Statement of the Problem

The determination of the right amount of markup is an essential task to all contractors. However, how to determine this amount is not an easy task. Some contractors use mathematical models to identify this amount and others use subjective judgement, but is it possible to determine the markup that will help the contractor be the lowest bidder and at the same time maximize his profit? Neither mathematical models nor pure subjective judgement proved to be the answer to this difficult question (21).

Another problem arises if it is realized that the contractor should not bid all jobs to win. It is known that any contractor, no matter how large, will not be able to handle projects beyond his capacity. However, some contractors bid not only to get jobs, but also to reduce their competitors' profit, to tell everybody that they are still in business etc. Recognizing these facts, contractors should increase their profit margin on some jobs and reduce it in

others. They should do this depending on internal and external factors. It should also be noted that contractors will not bid all jobs. How does a contractor select the right jobs to bid? What determines the right markup on these jobs? These are the two most important points discussed in this study.

1.3 Objectives

The main objectives of this study can be summarized as follows:

1. Determining the factors that influence the decision of the contractors operating in Saudi Arabia to bid or not, and how important each factor is.
2. Studying the factors that affect decision making on the size of markup to be applied to different jobs undertaken by contractors in the Saudi bidding environment, and the level of influence of these factors.

1.4 Scope & Limitations

The scope of this study is to determine the factors that affect the decision to bid or not and the amount of markup to be added. This study is limited to the construction industry in Saudi Arabia. This study is also limited to the competitive bidding situation.

Chapter 2

LITERATURE REVIEW

The literature has much material concerning competitive bidding strategy models. However, there is very little about the application of these models to the construction industry.

An overview can lead to the conclusion that most of the models that have been developed are quantitative models. Unfortunately, none of these quantitative models seem to have been implemented in the construction industry. Ahmed and Minkhara (1) found that fewer than 10% of American top contractors use some kind of mathematical or statistical model to aid them in their markup decisions. Another approach that could be introduced to the construction industry is the qualitative approach.

In recent years there has been some inclination towards the qualitative models. In this review, quantitative models are studied to find out what is wrong with them that construction industry does not utilize them. Qualitative models are also reviewed, and the two approaches are compared.

2.1 Quantitative Studies

There are two quantitative approaches appearing in the literature as solutions for the competitive bidding problem. The first approach depends on statistical decisions and was introduced to aid in solving the competitive bidding problem in the construction industry. The second approach is the game theory approach which is not widely implemented in the construction industry.

There are some basic differences in the assumptions of the two approaches. "Game theory assumes a rational intelligent opponent whose interests are completely opposed to those of the other opponents"(9). On the other hand, statistical decision theory assumes that competition is of a consistent nature and that it can be described by a probability distribution (9). Another important point is that game theory assumes that the utility of the possible outcomes for each player is known to all other opponents (9).

In this literature review the emphasis is on statistical decision theory models because they are the ones that constitute the majority of all mathematical models developed for use in the construction industry. Another reason is the fact that game theory has certain shortcomings that would make it difficult to apply to the competitive bidding problem (9).

2.1.1 Decision Theory (Quantitative) Models

Since the first introduction of this approach by Friedman in 1955 (17), many writers have become interested in the subject and tried to improve Friedman's model so as to be more applicable to the real construction environment. Some of these writers followed Friedman's basic assumptions (see section 2.1.2) while others tried to change some of them.

In this thesis the discussion is focused on the basic assumptions that underlie the models, because it is believed that unless the assumptions are realistic the whole bidding model will be of no real use in the construction environment. It is important to notice that the mathematical derivation of the models is not considered here. In other words, a model can be mathematically sound but still not be implemented if not based on the proper assumptions.

2.1.2 Friedman's Model

As mentioned earlier, the most important point being examined in this review is the validity of the model's assumptions. Friedman's model is based on the following basic assumptions :(17)

1. The probability distribution of each bid-to-cost ratio of the competitors does not depend on the contractor's cost estimate or his bid-to-cost ratio.

2. The bid-to-cost ratios of all competitors are independent, which means that the probability of beating the known competitors is simply the product of the probabilities of beating each competitor alone.
3. The cost estimates of all contractors are identical.
4. Profit in Friedman's model is calculated as the difference between the bid price and the estimated cost of the project, which suggests that actual cost equals estimated cost.
5. Another point that can be seen as an assumption is the average competitor concept which suggests that if the contractor does not know the identity of his competitors, he can simply create an average competitor, and the probability of beating the actual competitors will be the product of the probabilities of beating the same number of average competitors (15,17).
6. Another assumption is that the number of competitors on any job is related to the job cost (45). This relation is based on the argument that larger jobs will attract more contractors (17).

Another important point to be considered is the concept of expected profit which Friedman's model suggests. This concept implies that the expected profit is the product of the profit that is assumed to be realized from the job and the probability of winning the bid (being the lowest bidder). This implies that the expected profit which is realized upon losing the bid is zero (15,17).

At this point it would be convenient to study the assumptions to see if they comply with the real situation or not.

The first two assumptions suggest that the decisions of the competing contractors are independent, which means that each contractor behaves as if he is totally independent. That is because all the bid-to-cost ratios are independent, the probability of beating all competitors is the product of the probability of beating each, as suggested by the probability theory. This assumption cannot be valid in reality since the bidding environment changes with any information the contractor may know about his competitors (22). It is, for example, known that the competitors' bid prices will certainly affect the bid price of a contractor. Also, the identity of the competitors will have a similar effect on the contractor's bid. Thus, it can be concluded that the independence assumption is not realistic (22).

The third assumption is also not realistic because the estimated cost, no matter how accurate, will not equal the actual cost (45). In the construction industry, each project has a different mix of labor, material, equipment, supervision, subcontractors, location, climate, political environment, economical environment etc. Thus, the cost of any construction project is a random variable whose pattern is determined by one and only one probability distribution. It is, therefore, impossible to try to find a ratio between the estimated and actual costs and apply this ratio to future projects. Thus, this assumption can not be implemented in reality (17).

The fourth assumption suggests that the behavior of different contractors can be substituted by a theoretical average contractor. This is not the case in reality. It is not only impossible to do this, but also it is not right to assume that the same contractor will continue to behave the same, as implicitly assumed, in different jobs. Different contractors behave differently in different jobs. Also different contractors behave differently in similar jobs. It is also of great importance to know that the same contractor will behave differently in different jobs. The main cause for this is that jobs mean different things in different situations. The characteristics of a certain project, its location, the economic strength of the contractor, number of projects in hand, the owner etc., will certainly change the decision of the contractor in such a way that no one, except this particular contractor, will be able to predict his course of action on his decision. Therefore, how could it be possible to average different contractors?

The assumption that the number of competitors increases as the cost of the project increases is not always true. Friedman did not prove this point or, at least, determine what kind of relationship exists (22,45).

At this point the main aspects of Friedman's model have been analyzed. This model has been accepted by many authors who also developed mathematical models that basically follow the same pattern and assumptions adopted by Friedman. In this chapter, some of these models are discussed. It should be remembered that the con-

cern here is to check the assumptions of these models, not their mathematical derivation.

One model that follows Friedman's basic assumptions was introduced by Park (9). The main objective of Park's model was to select the markup that will maximize the expected profit (9). This objective is the same as Friedman's; however, there are some differences in Park's model.

1. In his model, Park ignores the uncertainty associated with the cost of doing the work (9).
2. The statistical techniques adopted by Park were very primitive (9).
3. Park adopted the assumption of independence of competitors' bids (35).
4. Another assumption is that the number of bidders and the size of the job are the only factors that affect the markup (35).

In his model, Park developed two mathematical equations to relate the number of bidders to the optimal markup, and to relate the job size (cost) to the markup. In these two equations he used a constant x that ranges from (0.5-0.8) in the case of the number of bidders, and from (0.15-0.30) in the case of job cost. Unfortunately, he did not show the empirical derivation of these equations.

The equations developed by Park are :(9) $\left\{\frac{N_1}{N_2}\right\}^x = \frac{M_2}{M_1}\left\{\frac{C_1}{C_2}\right\}^x = \frac{M_2}{M_1}$

Where

N = number of bidders.

C = Cost of the job.

M = Optimal markup.

x = Constant.

A cursory look at this model suggests that it is even less realistic than Friedman's. A close look shows that the independence assumption is of no importance since it was not implemented in the model (9). The assumption that the number of bidders and the size of job are the only factors that affect the markup size is not realistic since these factors are only a small portion of a long list of factors that do affect the contractor's decision of the right markup.

The other assumption about the simple relationship between the markup, the job size, and the number of bidders is not convincing since the problem is much more complicated involving numerous factors affecting markup size. It should also be considered that Park did not show how to find the exact values of (x), a problem which destroys the whole model since (x) is a very important factor in solving the equations (9).

Another mathematical model that follows the basic assumptions of Friedman was introduced by Howard (9). His objective was the same as in Friedman's model. He also assumes that the estimated cost equals the actual cost.

An assumption that is different from Friedman's is that it is only necessary to bid lower than the lowest bidder to win the contract (9).

Howard further assumes that the cost of performing the work and the lowest bid are independent of the others bids, and that other costs are independent of the lowest competitor's bid (9).

It is important to note that the final equation derived by Howard is the same as Friedman's equation if the bias factor is assumed to be one (9).

The first assumption was discussed before and it has been concluded that it is not realistic. The second assumption is realistic since it is the hope of all contractors to bid lower than the lowest bidder, but this assumption does not change the basic problem of how to bid lower than the lowest bidder. The third assumption of independence is not valid as discussed before.

In general it can be said that since both models used almost the same assumptions and came up with the same conclusions and equations, and since Friedman's model was judged to be not realistic, then Howard's model is no exception.

Another model that was introduced is the OPBID model which stands for optimum bid. This model was introduced to aid contractors in maximizing their expected profit.

This model considers more variables that affect the amount of markup the contractor should ask for. The variables considered are: (32)

1. Number of competitors.
2. Identity of competitors.
3. Class of work.
4. Cost estimate & true estimate.

There are some basic assumptions of the OPBID model those are as follows: (32)

1. The contractor's true cost is equal to his estimated cost.
2. Competitors will continue to bid as they have in the past.
3. There is no collusion among competitors.
4. The submission of individual bids are statistically independent events.
5. The contractor can do the work on all contracts he wins.
6. The contractor's office overhead is prorated on the basis of project cost over all contracts won.
7. The contractor's probability of being the lowest bidder and his expected profit vary inversely with the number of competitors.
8. The probability of the contractor being the lowest bidder equals the product of the probabilities of beating all of his competitors.

Analysis of the assumptions:

The first four assumptions were discussed previously and were concluded to be not realistic.

The fifth assumption may or may not be true because not all contractors can do all the work they win, so this assumption is only theoretical. Assumption 6 can be seen from the same angle as assumption 5.

The seventh assumption states a clear relationship between the contractor's probability of being the lowest bidder, his expected profit, and the number of competitors. The relationship is said to be inverse, but what proof is there to support this assumption? The author of the article wrote, "The real-world data used to test OPBID is not deemed extensive enough to be conclusive but does seem to support Gates' contention (32)." This sentence disagrees with his previous assumption that the relationship is inverse because Gates' model suggests that there is no connection between the mark-up and the number of bidders (22). However, this assumption may or may not be true.

The eighth assumption was discussed and found not valid. The last assumption classifies bidders into key competitors and average competitors. Key competitors are identified on the basis of the percentage of past contracts they participated in. If this percentage is greater than an arbitrary key number, a ratio between zero and one, the competitor is considered a key competitor; otherwise he is

an average one (32). This concept of average or identical competitor is not realistic, as discussed before, because no one can be sure that the contractor will continue with the same strategy in different situations.

Finally, there are two important differences between the OPBID model and the previous ones. The first difference is the use of a discrete probabilistic model which the author suggests will make it easier for different contractors to approximate their data (32). It is also claimed that the previous models, continuous models, have inherent curve-smoothing errors associated with them (32). This point seems to be valid but still it is an approximation of the real situation because the problem is seen from a narrow angle and only a few factors are considered.

The second difference lies in the use of a time-dependent data weighting scheme. It is a common practice for a contractor to not follow the same path of action for different jobs; keeping this in mind, he tries to modify data and put more weight on recent information, but is it possible to know all necessary information about competitors and thus modify the data accordingly?

Another model adopting Friedman's assumptions was introduced in 1973 by Beckmann (7). In his model, Beckmann assumes that all competitors have the same cost distribution and that the profit received from a bid will be inversely related with the number of bidders (7).

This model supports Friedman's findings and his assumptions of independence and the relationship between profit and the number of competitors. It is, therefore, not as realistic as Friedman's.

An important model was introduced by Carr (12). This model agrees with some of Friedman's assumptions and disagrees with others. Carr's model is based on Friedman's main assumptions, but it agrees with Gates' findings more than Friedman's. The basic assumptions of Carr's model are: (12)

1. It is only important to bid lower than the lowest bidder to win the job.
2. The standardized cost of a contractor "i" is independent of the standardized bid of another contractor "j".
3. When the average competitor's concept is employed (not enough information), three assumptions are used:
   a. Bidders have the same variance in their cost estimate.
   b. Variances in cost estimates are substantially greater than variances in markups.
   c. The magnitudes of markups are not large.
4. The number of competitors is inversely related to the contractor's profit, and the competitors' adjustment of their markups undercut the contractor's markup (13).
5. The costs and bids of competitors are assumed to be random variables and thus the bid-to-cost ratio for a certain project is probabilistic (13).
6. It is assumed that all competitors are using the same markup adjustments as the number of competitors changes (13).

An attempt to analyze the previous assumptions shows that the first assumption is valid but not how to implement it. The second assumption supports the idea of independence initiated by Friedman. The third group of assumptions are all not realistic because:

1. It is not common in real bidding for different contractors to have the same variance in their cost estimates.
2. No one can be sure that all competitors have variance in their cost estimates substantially greater than variance in markups; this may only be implemented theoretically.
3. There is no logic in assuming that all markups are not-large.

It can be seen that these three assumptions are just theoretical attempts to simplify the real life situation. They cannot exist in real practice and even if they do, they are special cases only; a special case cannot be generalized without sufficient supporting evidence.

The fourth assumption was discussed previously; the new angle on it is the markup adjustment, which, if done by competitors as assumed will minimize the profit realized from a job. This assumption is not supported by proof; it may or may not be true.

The fifth assumption is valid, but it is not used in the development of the model. If costs and bids are considered random variables, the problem becomes more complicated and approach reality, and it would be hard to model. The last assumption does not have to be true; if true, it is only a special case.

In general, this model uses all Friedman's assumptions except the assumption that the bid-to-cost ratios are constant. This model assumes that bid-to-cost ratios are probabilistic which is more realistic; but still the model is not applicable to real practice because it does not consider the problem as a whole.

Another model was introduced by Wade & Harris (45). This model was called LOMARK, which stands for local market. The basic assumptions of the model are: (45)

1. The identity of all competitors is well known.
2. There is a relationship between the number of bidders and job cost. This relationship is not as dependent as Friedman suggested; rather, it is a logarithmic relationship.
3. There is a relationship between markup and job cost, but not exponential as Park suggested, however, it is not linear.
4. The most important assumption is that the relationship between bids is dependent.

There are other assumptions but they basically agree with Friedman's so there is no need to mention them.

The first assumption limits the model to an identified local market, since the model will operate only if all competitors are well known. This model does not use the average competitor concept. "When a contractor bids outside his local market, he should not use his local data to predict bidding results. There is no statistical basis for imputting his data to alien contractors, or even to a so-called average bidder (45)." That is, the model is developed from a

specified population. Its predictability decreases when it is implemented in determining the markup size of a project to be awarded in another jursdiction.

It is suggested by the second assumption that a substantial increase in the job cost has to occur before it causes an increase in the number of bidders. This assumption may be more realistic, but is it indeed only job cost that affects the number of bidders in real practice?

The third assumption claims that the relationship between job cost and markup is not linear. This is also not the only factor; markup is affected by other factors that are not considered in this model.

The last assumption is the basic difference between this model and Friedman's. It suggests dependence between bids which seems to agree with reality.

This model shows some realistic merits but unfortunately it does not incorporate the whole picture. The author said, "construction firms, individually and collectively, are constrained by other factors such as geographic location, class of construction, equipment parameters, governmental laws and regulations, bonding requirements, and financial constraint. It would be naive to develop a business strategy without including, at least implicitly, effects caused by such constraints (45)." It is unfortunate that although the writer recognizes these factors he did not use them in developing his model, not even implicitly.

There are many other models based on Friedman's assumptions. These include a model introduced by Sugrue (43), another introduced by the same author in 1982 (44), a third introduced by Shaffer (40,41) , a fourth by Whittaker (46), a fifth by Hanssmann & Rivett (27), a sixth by Bell (8), another by Fuerst (20), and finally a model by de Neufville, Hani & Lesage (33).

2.1.3 Gates' Model

This model is the other most important in the literature. The pioneer of this school is Marvin Gates. The first article by Gates discussing the competitive bidding problem came out in 1960 (26). However, the real formulation of his bidding model was published in 1967 (23). Since then much has been written about Gates' model, and other models were developed using his assumptions.

Gates' model is dependent on the pioneering work of Friedman. The basic assumptions of both models are the same, but they differ on two points. The first point of disagreement is the assumption of independence. Gates' model does not assume that bid-to-cost ratios are independent. It does, however, assume that outcomes of different competitors are dependent (23). For example, the outcome that contractor "A" wins depends on the remaining contractors losing (22,23). This assumption is more realistic, but when applied to the bidding model it ignores a very important aspect of bidding in real practice. In his model, Gates assumes that if there are seven competitors then the chance that any one of them will be the winner is 1/7 (23); but is this really the situation? The study of bidding behavior in reality assures us that this assumption is not valid because the lowest bidder is not randomly selected, as implicitly assumed by Gates. The assumption that each of the seven competitors will have an equal chance of being the lowest bidder suggests that the bid price is of no importance. In reality the winner is always the lowest bidder, and no matter how many other competitors

there are, if one is the lowest, then he and only he will be the winner. Gates' assumption is based on the statistical foundation that if there are seven equal balls the probability of randomly selecting one of them is one in seven but as discussed above, this is not the case because no random selection is utilized in awarding the bid, and moreover, the contractors are not similar: they submit different bids from which the least will be selected (18).

The second point of disagreement between Friedman and Gates is the relationship between the number of competitors and the cost of the job. Friedman, as discussed earlier, suggested that as the size of the project increases, the number of competitors increases. On the other extreme, Gates suggests that there is no relationship between the number of bidders for a construction project and the cost of the project (23). Gates continues his discussion and says that his assumption does not in any way conflict with the fact that the greater the number of bidders, the lower will be the lowest bid (23). The study of different articles gives the impression that neither assumption can be taken as the ultimate truth. There is not enough evidence supporting either. However, it seems that the number of competitors does affect the contractors' decision in one way or another.

Another assumption that was not discussed previously is that the only reason for contractors to bid a job is to maximize their profit (23). This assumption is not valid because contractors bid on different jobs for different reasons. The objective of minimizing losses

is one reason for bidding. Another reason is to minimize the profit of competitors; another is to keep production, etc. (23). Realizing this fact, it should be noted that the whole structure of the model is weak. It can be argued that the behavior of contractors can not be studied because each bid is based on different objectives; thus, the analysis of past information concerning the bids of different contractors on different jobs will not be that useful and may be misleading.

In addition to the previous assumptions stated by Gates, there are other assumptions that are basically the same as Friedman's. He assumes that actual cost equals estimated cost , and he uses the concept of average bidder, etc.

In general, it can be concluded that the Gates model does not apply to a real construction environment because it is based on unrealistic assumptions, and it does not try to solve the problem as a whole but ignores very important factors which, if considered, would change the whole model (13)

There are many other models that defend Gates' ideas and utilize his basic assumptions. One model that agrees with Gates was introduced by Dixie (16). Another model was introduced by Oren & Williams (34). Another was developed by Winkler & Brooks (48).

2.1.4 Evaluation of Quantitative Studies

Until now the main goal was to analyze the assumptions of both the Friedman and Gates models. At this point different opinions about both models are presented to see if one model is more appropriate than the other, or if both are invalid.

John Dixie wrote "I do not agree that both Friedman's expression and Gates' expression are correct ....It is concluded that Gates' formula is the correct one to use (16)."

Gates conducted an experiment to test which model is the correct one The experiment was known as a "Monte Carlo Experiment". This expriment relies on random digits. Five different groups of experiments and one modification were run three times and were equivalent to 10,000 trials (25). The conclusion of the experiment was "The observed results were recorded and compared with the theoretical results from Friedman's model and Gates' model 48 times. The comparisons are striking. For without exception Friedman's model fails completely whenever more than one competitor is involved. On the other hand, by inspection, it is equally apparent that Gates' model and the observed results have an overwhelming convincing high degree of correlation (25)."

Michael Fuerst, one of Friedman's defendants, wrote an article attacking Gates' findings in the Monte Carlo Experiment; he states: "Gates had intended to explore the dispute (between Gates' model and Friedman's model) in its most fundamental terms, but having

misinterpreted the Friedman model, his efforts and all those hours counting dots were in vain (19)."

He added "Even if Gates had not misinterpreted Friedman's model, one should still be concerned with his analysis, since application of basic concepts from a sophomore level undergraduate course in probability theory would have resulted in a more straight forward and exact analysis (19)."

Fuerst concluded that "... only under special circumstances are either Friedman's or Gates' equations valid (19)."

In reply to Michael Fuerst's attacks, Marvin Gates said "The discusser's initial rejection of Friedman's model was made 10 years ago on the basis of 15 years experience as a construction professional. Which construction cost estimators agree with Friedman's model that the probability of winning over three competitors in a single project is the same as winning over each of them on three separate bids , when P(A)=P(B)=P(C)=0.50? More importantly, not Fuerst or any other adherent of Friedman's model has addressed himself to this obvious incongruity objected to by this discusser (Michael Fuerst) 10 years ago (24)."

Another article was published by Fuerst in 1976 (18). In this article the author tries to give some truths and comments. In his article Fuerst says : "According to Dixie, the award of the contract can now be modeled by selecting a ball at random, and awarding the bidder whose number appears on the ball. The error to be

explained is that the method of selection of each "q" changes the meaning of the p(i) ! (18)."

He also says; "One should note that the case for which all bids are assumed to be drawn from the same distribution is a special case (18)."

He adds, "The actual cost cannot ever be known a priori and may, after contract completion, be difficult to ascertain in terms of the original estimate due to post bid design changes and accounting practices (18)."

Finally he states, "The reader who wishes to argue that the unbiasin factors are unneeded because a good estimating staff will produce unbiased estimates is reminded that although, on the average, estimates are unbiased, a firm is more likely to submit the low bid on those jobs for which costs are underestimated (18)."

James E. Spooner discussed some models proposed by Louis R. Shaffer and Terry W. Michael, and found that the contractors' results are better than the models' results.

Spooner says, "Although bidding models are interesting and useful classroom tools, the writer believes that a contractor will be unwise to rely on a crude statistical tool over his own hard-won experience, especially where the results from the model do not show a significant improvement over his own unaided performance (42)."

A discussion by Matthew Rosenshine suggests that "the great fallacy in the controversy surrounding bidding models is the belief that no more than one true model exists (24)."

Another statement by the author says, "However, in addition to being analytically correct, a good model must represent the aspects of reality it purports to represent (24)."

In another part the author says, "The important problem remains, i.e., which model better reflects reality? Hopefully future efforts along the line of the author's paper will deal more exclusively with which model, Friedman or Gates, matches real world bidding data. The answer to this question may be neither but it is hardly likely to be both (24)."

In another discussion the same author, Rosenshine, says, "Both have been shown to be correct in their own way, Friedman's model as a tool to determine an optimum bid and Gates' model as a description of the results of bidding competitors (38)."

A discussion by Benjamin and Meador about the results of the Monte Carlo Experiment suggests the following: "There is a closer correspondence between the relative frequency of successful bid and the probability of winning when Gates' model is used than when Friedman's model is used (10)."

Ringwald says, "At present there seems to be no consensus supporting either Gates or Friedman models. A study made by Benjamin and Meador showed that an application of the two models to a

set of actual bids by a real contractor over a period of several years produced widely differing low-bid probability and markup level figures between the two approaches (37)."

An important statement was introduced in an article by Carr "Friedman and Gates have modeled the relationship between markup and probability of winning a bidding competition. Each model is based on a different assumption, neither of which is correct for most construction bidding (13)."

After considering the previous opinions, it seems that no one thinks that one or both models are always correct. It is evident that even those that fight for one model against the other admit that their model is not the right answer, and that it can be applied in some cases and with certain limitations.

A very important article was published by Gates in 1983 (21). In this article he abandoned all his previous and Friedman's work (21). Gates thinks that the mathematical approach is of no real benefit since the problem is much too complicated to be solved by some approximations or assumptions (21). Instead, full reliance on subjective insights is substituted for the numerical data (21).

If after all these articles, and the controversy over his and Friedman's models that lasted for more than 15 years, there must be a very strong reason for Gates to abandon all of his work. This

act by Gates suggests that the mathematical models developed did not succeed in finding the answer for the competitive bidding problem. After this conclusion, certain questions arise and need to be answered. One important question is, were these models adopted by contractors and found to be unreliable?

To answer this question, a study was conducted in the United States and the question was asked of 400 top construction firms. The result was that only 10% of these firms are using some kind of statistical tools to guide them (1). Why is it only 10% of these firms?

The reason for this behavior can be seen as a logical result for the unrealistic assumptions underlying the models. But why use unrealistic assumptions? Reality is always complicated, no real solution is possible, when construction industry is the seen, the problem is even worse. Construction is by its very nature a risky business; it is uncertain, depending on predictions, guessing and probabilities. This environment makes life difficult for researchers so they try to choose easy solutions and build their models on shakey foundations.

This situation leads to the anticipated result that contractors will not use these models. But is this action to the benefit of the contractors, the owners, the whole industry, or is it better to use some kind of mathematical guidance? This is one of the most difficult questions. Usually contractors will not take the risk and use any model unless they are almost certain of the benefits they may obtain. Another reason is that the construction industry has the

characteristic of being conservative and avoids new ideas or methods.

All these aspects lead to questions to be answered, such as, can these models be modified to obtain a more realistic solution? A model that considers all the variables may prove to be the right answer. This study attempts to find all the variables. These variables may be the basis for such a model. The other question is, is it possible to find a better way of approaching the problem? If there is another way, what is it?

2.2 Qualitative Studies

A substitution introduced by Gates is called the "Delphi" method (21). This method is not mathematical; instead, it was introduced to replace mathematical models, including Gates' model. The Expert Subjective Pragmatic Estimate (ESPE) improves and refines the strategic thinking that pervaded the bidding process (21). This new method can be defined as a non-mathematical method for finding the optimal bid that will maximize the contractor's profit. The procedure starts with making an estimate of the range and distribution of the possible low bids of the competitors (21). Then another estimate is made for the firm's range and distribution of his possible low bids. The two sets are then compared to determine the most appropriate bid. Finally an adjustment is made to correct the

implied continuous distribution for the actual discrete situation (21). This method is a simple forecasting method based on ESPE. The ESPE is done by a group of experts who through iterative process will finally estimate the optimal bid.

An important point to be understood is that this method is not simply guessing, as may be considered by some. Rather it can be seen as an educated guessing tool, or, as said by some experts, it is not guessing at all. It is the estimator's considered opinion based on his total education, experience and knowledge; his perception of the project in whole and in part; his sense of his company's competitors needs, capabilities, limitations; his feel for the construction estimate and bidding environment; and other influencing factors (21).

In conclusion, it can be said that this method is "based on common sense, engineering logic (experience), and elementary mathematics (21)."

Another question is, if contractors do not use mathematical models what do they use? A study was conducted in 1988 (1) tried to answer different questions; one of these is the above stated. The answer can be understood from the following statements: (1)

"We do 85% negotiated work. We do not like to bid."

"Bidding is more of an art than a science and results are more controlled by bidding errors than any other factor."

"We are committed to developing long-term relationships with our clients. We, therefore, continue to bid work to establish or maintain a client relationship when necessary."

"Bidding for construction projects is absolutely foolish, but an evolutionary characteristic of the industry .... Unfortunately, those people who make mistakes also are successful."

"The art of successful estimating takes years of hands-on experience."

From the previous statements it appears that the majority of contractors do not use any mathematical models; they depend on their experience and no other thing.

The most important question remains. If contractors are satisfied with the way they are doing their jobs, and more important they do not wish to use any new method, why discuss different ways of improving bidding strategies?

To answer this question it has to be recalled that these findings are from a study done at the United States, while this study is done in Saudi Arabia. It is expected that different bidding climates will influence the responses and acts of contractors. A more important point to be remembered is that the bidding environment in Saudi Arabia during the boom is not the same as now (during a recession).

It can be said with almost certainty that in the past good economic situation, no contractor was concerned about any strategy since the demand for construction was so high that contractors were operating at full capacity. It is, therefore, logical to expect that competition was very low, and profit was very high.

The situation now is the opposite since the economic situation is different. There is no high demand for construction, there are many competitors, and profit margins are low. It is expected that this situation will change the behavior of contractors. No contractor can survive unless he is strong enough, and to be strong enough he has to work with more rationality and adopt any possible way to increase his profit margin, or at least keep him in business and minimize his losses. It is thus believed that the study of qualitative strategies will help contractors in their hard task.

Another point to be highlighted here is the fact that the literature has very few studies concerning the qualitative approach. Thus, it is hoped that this study will be another step on the way and that the results will open the door for more studies.

Chapter 3

RESEARCH METHODOLOGY

This chapter presents all the steps that were performed to achieve the objectives set for this study. The procedures include all information relevant to what data are needed, where and how these data were secured, and the method whereby a sample was selected.

3.1 Required Data

The study objectives necessitated the identification of the various factors that influence two critical decisions of any contractor. The first is the decision to bid on a project. The second is the decision related to the appropriate markup size. A thorough review of the literature was conducted for the purpose of studying the available bidding models. In this review, different quantitative and qualitative bidding techniques were studied and analyzed to ascertain their potential application in the construction industry in Saudi Arabia.

The study of the mathematical (quantitative) models made it clear that all of them viewed the problem from a very narrow angle. In their development, the models considered only some of the factors that could affect the size of the markup, but not all the factors.

A very important point is that the study of the models cleared the picture, and introduced many factors that can be considered when studying the problem of competitive bidding.

The literature review resulted in identifying thirty seven potential factors that can influence the contractors' decision to bid and markup size.

These factors are classified into five categories. One, project characteristics category includes all quality that describe the project such as size, owner's identity, duration, etc. Two, project- documents category constitutes all factors and characteristics of the bidding documents such as type of contract, design quality, owner special requirements, etc. Three, company characteristics includes factors relevant to the company such as need for work, current work load, experience in such projects, etc. Four, bidding situation includes all factors operating in the awarding of contract situation. This category includes factors such as competition, required bonds capacity, etc. Five, the economic situation category involves all economic indicators that may operate on the project. Indicators such as labor availability, government regulations, etc. are the elements of this category.

The relationships between these broad categories and the decisions relevant to bid and markup size is graphically portrayed in Figure 1.

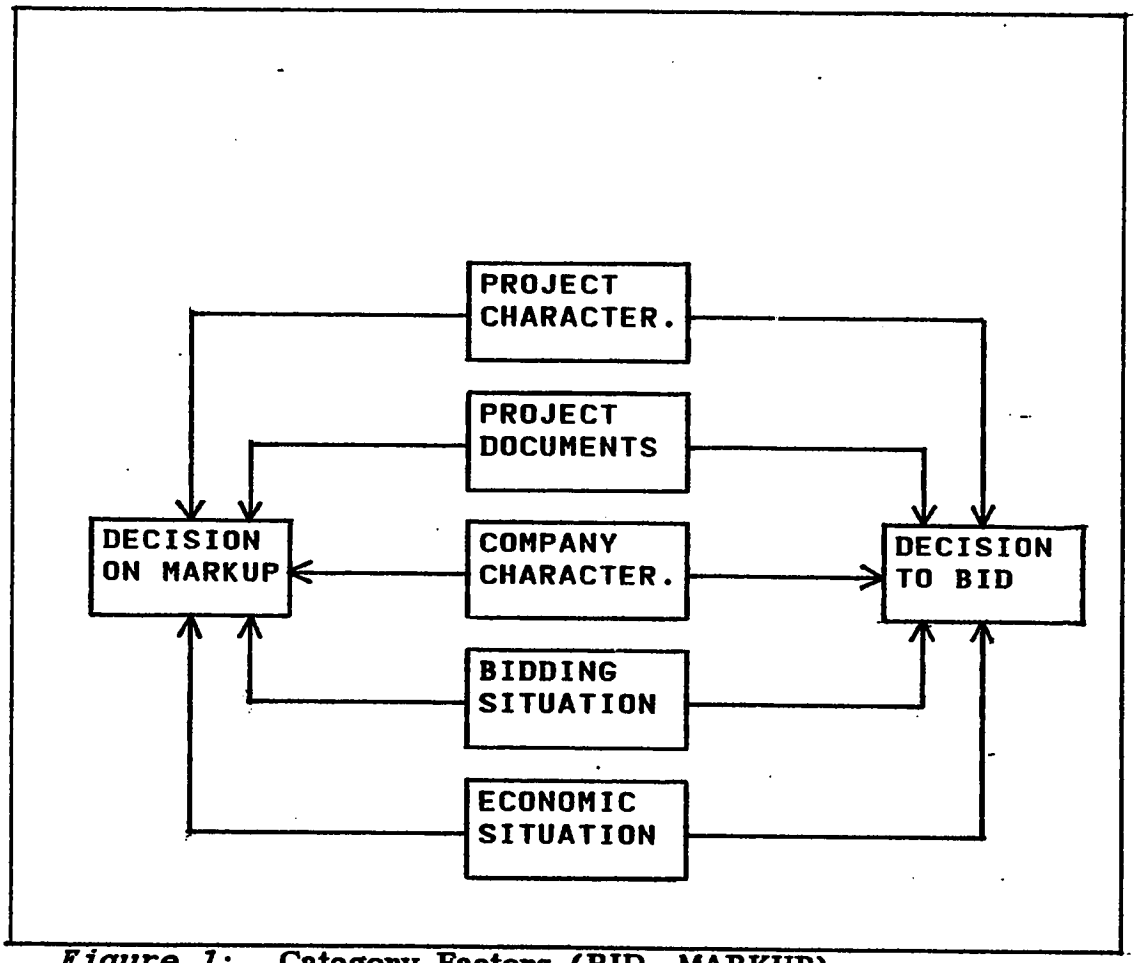

Figure 1: Category Factors (BID, MARKUP)

In general, the data tried to study the effect of different internal and external factors on the contractor's bidding and markup decisions. The internal factors are those related to the contractor's organization with all its assets, experience, and strength. The external factors are those related to the owner and his representative, the designer, the competitors, and finally the project and its

related conditions. These parties interact in a changing social, economical, technological, and political climate. The data collected should reflect the aggregate effect of the different parties on the contractor's bidding decisions.

3.2 Data Collection

The necessary data are collected primarily from the classified construction contractors in Saudi Arabia. The top manager who is involved in the bidding decision is the key informant who provides all the necessary information. Sixty-eight percent of the questionnaires were answered by the general manager.

The method used for the collection of the information is a written questionnaire. This questionnaire was originally prepared for a study done at the University of Cincinnati by Irtishad Ahmed and Essam Minkharah (1).

In this study, their questionnaire was modified to suit the bidding environment in Saudi Arabia. Some factors were added and others removed depending on which were deemed appropriate and applicable.

The questionnaire is divided into three parts. The first part contains questions about the firm, its type, its capacity, and other biographical data. The second part of the questionnaire contains

questions about the decision to bid or not to bid, and the decision on the size of markup to be assigned. In this part, a scale from 1-7 is used to measure the level of effect of each factor on the underlying decisions, where "1" means low level of effect and "7" means high effect. The respondents were asked to check a number on the scale which reflects their assessment regarding the different factors. The last part of the questionnaire contains questions that reflect the firm's policy regarding bidding decision making. A copy of the questionnaire appears in Appendix (I).

3.2.1 Sample Selection

The questionnaire was sent (English and Arabic) to a randomly selected sample contractors. The sample was selected from the 1990 Classified Contractors list which is published by Dammam Chamber of Commerce.

In order for a sample to be representative, three conditions must be met. These are: (10)

1. Equal Chance

This means that every element in the population has the same chance of being selected. In order to satisfy this condition, the sample was randomly selected. The procedures

that were followed to ensure the randomness of the sample are as follows:

a. A list which had all classified contractors was sequentially numbered.

b. Random numbers (from a statistical book) were selected according to a preset criteria (i.e. begin from right to left , top to bottom , take one row and leave the other, etc).

c. The random numbers selected were then compared with the numbers on the list, and accordingly certain subjects were selected.

2. Appropriateness

This means that the selected sample should precisely reflect the characteristics of the whole population. The sample subjects should have characteristics similar to those of the population.

3. Independence

Although this is not a problem when the sample is randomly selected, but it should be emphasised that the selection of one subject is totally independent from the selection of other subjects.

3.2.2 Sample Size

The total population of this study is all the classified contractors operating in Saudi Arabia. According to the Chamber of Commerce, there are 1,600 classified contractors.

In this study the size of the sample was determined using the following formula: (29)

$$n = \frac{n'}{1 + \frac{n'}{N}}$$

Where :

n = Sample size.

$$n' = \frac{s^2}{v^2}$$

N = Total population = 1600.

v = The standard error of sampling distribution = 0.05.

s= The maximum standard deviation in the population elements. (Total error= 0.1 at a confidence level of 95%).

$$s^2 = P*(1-P) = 0.5*0.5 = 0.25$$

P = The proportion of population elements that belong to the defined class.

Substituting the pre-defined variables the following sample size is introduced : n = 94

It is usually the case in such a study that the response rate will not be high, thus in this study a response rate of 30% was

assumed, and thus a total of 300 questionnaires were mailed to classified contractors all over the Kingdom. A total of 71 questionnaires were received. Thus, the actual response rate was 24%.

3.3 Data Analysis

The analysis of the data was through the use of SAS, Statistical Analysis System, which is a package available on the main frame of King Fahd University of Petroleum & Minerals.

The data collected from the survey was coded and entered into the system which calculated all required statistics, such as the mean, the standard deviation, and the correlation coefficients. The multivariate technique, discriminant analysis, was employed in a major portion of the data analysis.

Chapter 4

DECISION TO BID

Contractors always make two crucial decisions. The first is whether or not to bid a job that the contractor is invited to bid on. The second is the decision on the size of markup that should be added to a project cost. The former decision is discussed in this chapter, and the latter is presented and discussed in chapter 5.

In this chapter, the factors that influence the outcome of the bidding decision are introduced.

4.1 Factors Affecting the Decision to Bid

Contractors receive many invitations to bid for jobs. The invitation could be open or closed. The former is an invitation to all responsible contractors in the industry. An open invitation is used in all public projects. Owners, especially public, usually announce the invitation in local, national, and/or international newspapers, magazines, and trade journals.

Private owners have the freedom to limit their invitations to specific selected contractors. This bidding situation is known as closed bidding.

When a contractor receives an invitation (open or closed), he must make a decision on whether to accept or decline it. The importance of this decision emerges from its financial consequences. The decision suggests incurring substantial cost which may not be recovered immediately. Bidding a job requires the contractor to prepare an estimate. Estimate preparation entails the purchasing of the bidding documents and the commitment of resources of contractors.

There are many factors that affect the outcome of such a decision. Table 1 embodies 37 factors ranked in accordance to their importance to Saudi contractors.

The importance of the factors was calculated using the following formula (6):

Importance Index = $\sum[a*X]*100/7$

Where:

a= Constant expressing the weight given to each response. The weight ranges from 1 to 7 where 1 is least important and 7 is most important.

$X=\frac{n}{N}$

n= The frequency of the response.

N= Total number of responses.

TABLE 1: Factors Affecting the Decision to Bid

Rank	Factor	Imp.
	A. PROJECT CHARACTERISTICS	79.37
1	Project cash flow	87.96
6	Size of contract in SR	83.09
11	Location of project	81.29
15	Type of equipment required	79.07
18	Owner	78.67
29	Duration	73.88
31	Job start time	71.64
	B. PROJECT DOCUMENTS	78.02
3	Type of contract	86.32
22	Design quality	78.05
28	Designer (A/E)	74.45
30	Owner special requirements	73.26
	C. COMPANY CHARACTERISTICS	78.07
2	Availability of required cash	86.92
4	Availability of qualified staff	86.12
5	Experience in such projects	83.67
7	Confidence in work force	82.49
8	Need for work	82.45
9	Establishing long relation with clients	81.84
13	Strength in industry	80.68
16	Current work load	78.78
17	Uncertainty in cost estimate	78.78
21	Past profit in similar jobs	78.16
25	Reliability of subcontractors	76.33
33	General (office) overhead	70.62
34	Public exposure	68.98
37	Portion subcontracted to others	57.14
	D. BIDDING SITUATION	72.78
20	Competition	78.47
23	Time allowed for submitting bids	77.55
26	Required bond capacity	75.57
32	Bidding document price	71.02
35	Prequalification requirements	67.96
36	Time of bidding (season)	66.12
	E. ECONOMIC SITUATION	78.72
10	Overall economy (availability of work)	81.49
12	Quality of available labor	80.68
14	Availability of labor	80.08
19	Risk involved in investment	78.57
24	Availability of equipment	76.66
27	Governmental division requirements	74.84

Studying table 1, it is obvious that all 37 factors can be considered important to the contractors operating in Saudi Arabia.

If the broad categories are considered, the same behavior is noticed. The importance of the five categories is almost the same. The lowest is the bidding situation category with an average importance index of 72.78, and the highest is project characteristics with an average importance index of 79.37. Figure 2 shows the behavior of the broad categories.

However, the degree of importance of the 37 factors and the five broad categories may change as the size of the contractor changes from small to medium to large.

In this study, the business volume was used to classify contractors into three classes as follows:

1. Business Volume < SR 50 million (Small)
2. Business Volume > SR 140 million (Large)
3. SR 50 million < Business Volume < SR 140 million (Medium).

Appendix (II) contains information related to contractors' characteristics such as type, size, and grade.

At this stage it is convenient to study how the importance of the 37 factors and the five broad categories change as the contractor's size changes.

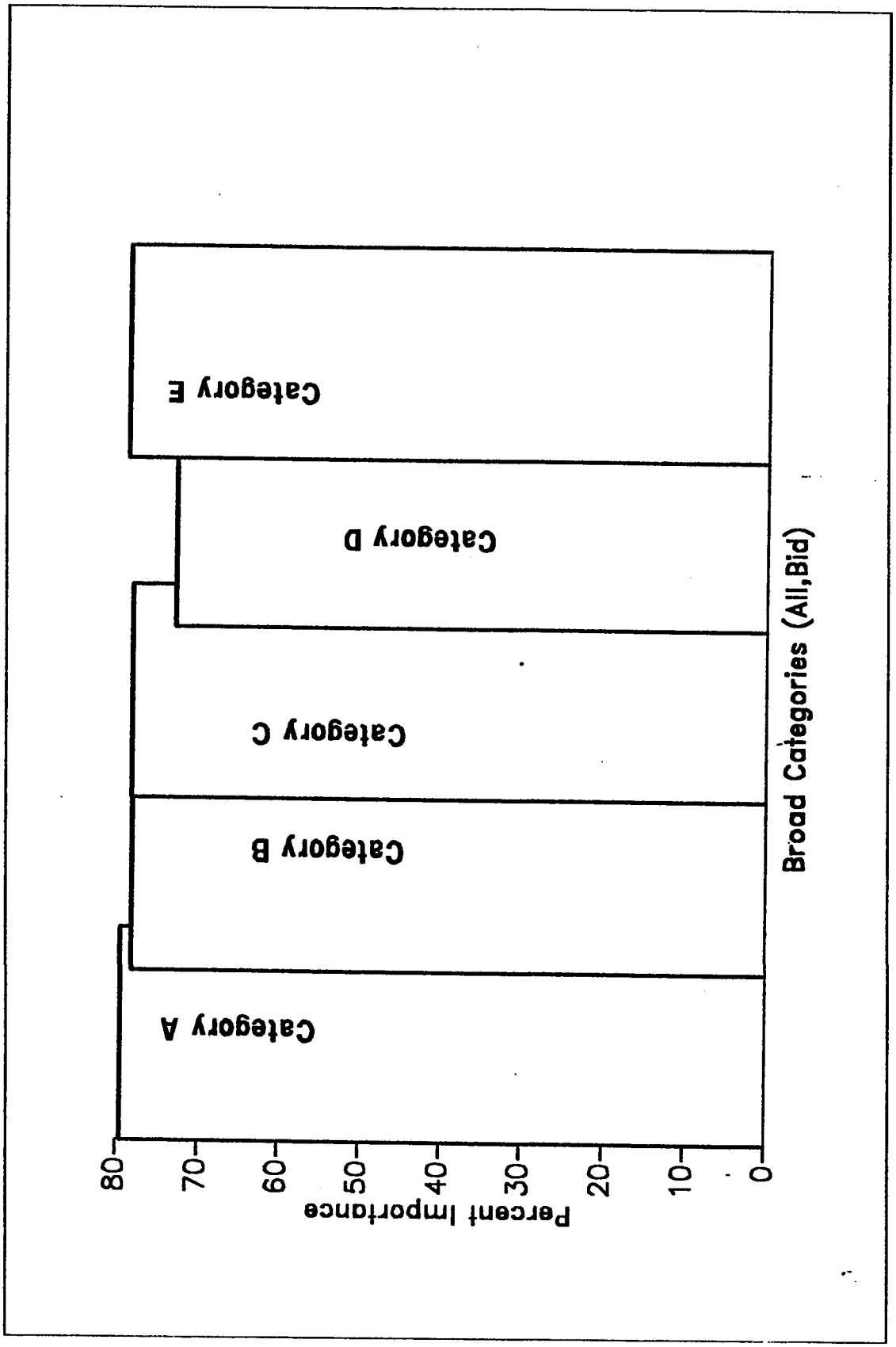

Figure 2: Broad Categories (Bid or Not)

Reviewing tables 2,3, and 4, it is evident that almost all the 37 factors are considered important for all the three sizes of contractors.

Figures 3,4, and 5 show the behavior of the broad categories. It is obvious that the three classes are within the same range. No dramatic differences appear as the size changes from small to medium to large.

Pearson correlation coefficients were calculated to see the degree of association between the three classes. A correlation coefficient between small and medium firms was found to be 0.615 which suggests a relatively high association. Between small and large the coefficient was 0.458, and between medium and large, 0.566. The correlation coefficients show that the three classes have something in common but they are not identical.

Discriminant analysis was used to test if the differences mentioned earlier exist, and whether contractor size has similar characteristics that differentiate it from other sizes.

The assumptions of the discriminant analysis are as follows: (28)

1. "Two or more groups.
2. At least two cases per group.
3. Any number of discriminating variables, provided that it is less than the total number of cases minus two.
4. Discriminating variables are measured at least on an interval scale.

5. No discriminating variable may be a linear combination of other variables.

6. The covariance matrices for each group must be equal.

7. Each group has been drawn from a population with a multivariate normal distribution on the discriminating variables."

TABLE 2: Ranked Factors (Small, Bid)

Rank	Factor	Imp.
	A.PROJECT CHARACTERISTICS	82.20
1	Project cash flow	91.94
8	Location of project	86.43
14	Size of contract in SR	83.21
15	Owner	82.50
24	Type of equipment required	79.64
30	Duration	77.50
34	Job start time	74.21
	B. PROJECT DOCUMENTS	81.40
6	Type of contract	88.21
17	Design quality	81.58
23	Designer (A/E)	80.00
32	Owner special requirements	75.82
	C. COMPANY CHARACTERISTICS	81.47
2	Availability of qualified staff	91.43
3	Establishing long relation with clients	91.20
4	Availability of required cash	90.71
5	Experience in such projects	88.64
7	Confidence in work force	87.50
11	Need for work	84.64
16	Strength in industry	82.14
22	Current work load	80.59
25	Past profit in similar jobs	79.64
26	Reliability of subcontractors	79.12
27	Public exposure	79.12
29	Uncertainty in cost estimate	77.66
36	General (office) overhead	71.78
37	Portion subcontracted to others	56.41
	D. BIDDING SITUATION	78.50
13	Competition	84.28
18	Required bond capacity	81.32
19	Time allowed for submitting bids	80.95
31	Bidding document price	76.92
33	Prequalification requirements	74.36
35	Time of bidding (season)	73.21
	E. ECONOMIC SITUATION	82.54
9	Availability of labor	85.71
10	Overall economy (availability of work)	85.00
12	Quality of available labor	84.28
20	Governmental division requirements	80.95
21	Availability of equipment	80.71
28	Risk involved in investment	78.57

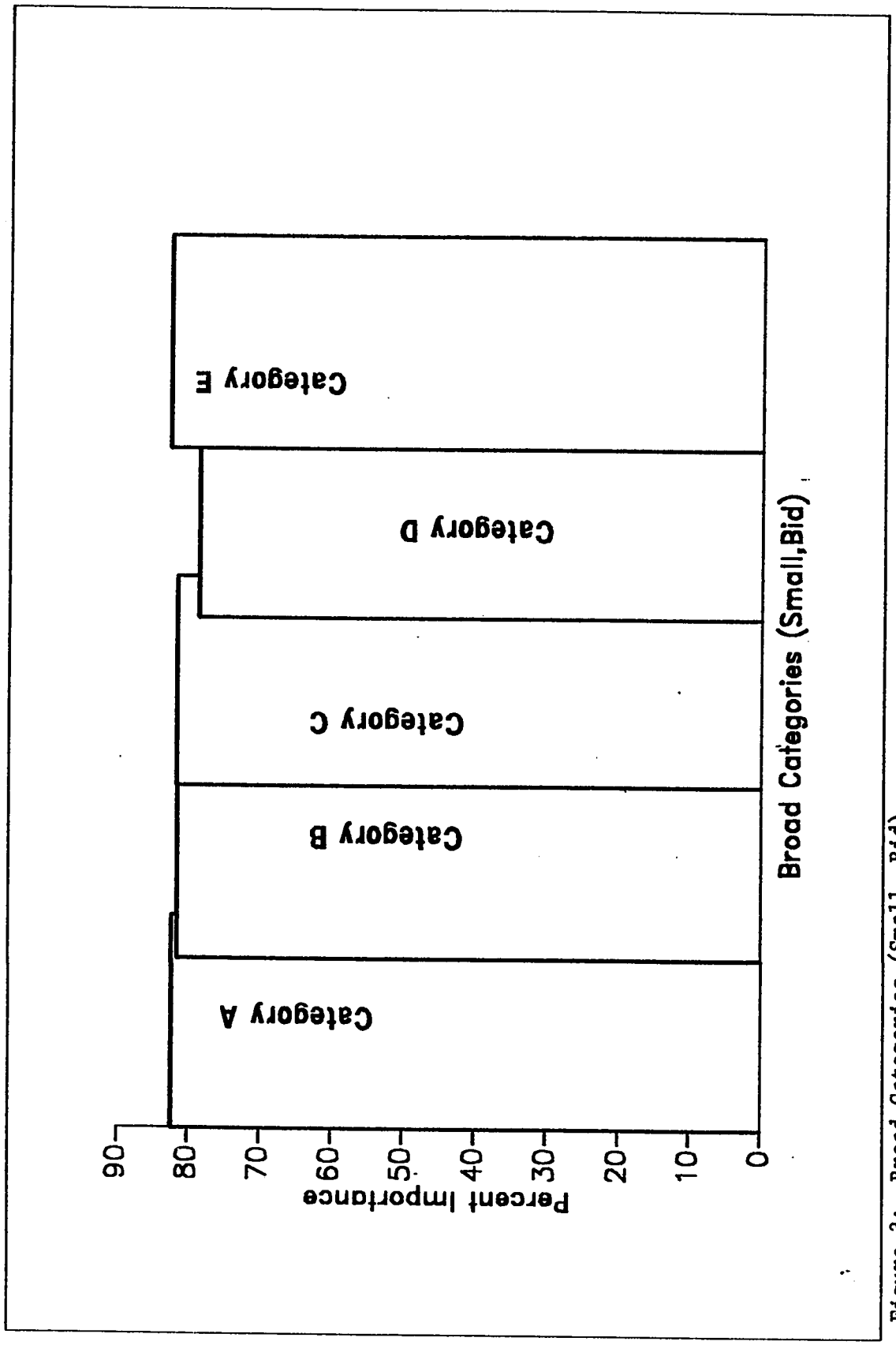

Figure 3: Broad Categories (Small, Bid)

TABLE 3: Ranked Factors (Medium, Bid)

Rank	Factor	Imp.
	A. PROJECT CHARACTERISTICS	75.88
1	Size of contract in SR	84.42
2	Project cash flow	83.77
10	Location of project	76.62
11	Owner	76.62
16	Type of equipment required	74.68
29	Duration	68.83
32	Job start time	66.23
	B. PROJECT DOCUMENTS	72.56
3	Type of contract	83.12
21	Design quality	70.78
22	Owner special requirements	70.78
33	Designer (A/E)	65.58
	C. COMPANY CHARACTERISTICS	73.20
4	Availability of required cash	83.11
5	Need for work	80.27
6	Uncertainty in cost estimate	79.59
7	Experience in such projects	78.57
8	Strength in industry	77.27
12	Current work load	76.43
14	Past profit in similar jobs	76.19
15	Availability of qualified staff	75.32
17	Confidence in work force	74.68
23	Reliability of subcontractors	70.13
24	General (office) overhead	70.13
26	Establishing long relation with clients	70.13
36	Portion subcontracted to others	56.49
37	Public exposure	56.49
	D. BIDDING SITUATION	67.63
18	Competition	74.03
25	Time allowed for submitting bids	70.13
30	Bidding document price	68.83
31	Required bond capacity	67.34
34	Prequalification requirements	65.58
35	Time of bidding (season)	59.86
	E. ECONOMIC SITUATION	72.32
9	Overall economy (availability of work)	76.62
13	Risk involved in investment	76.19
19	Availability of equipment	71.43
20	Quality of available labor	70.78
27	Availability of labor	69.48
28	Governmental division requirements	69.39

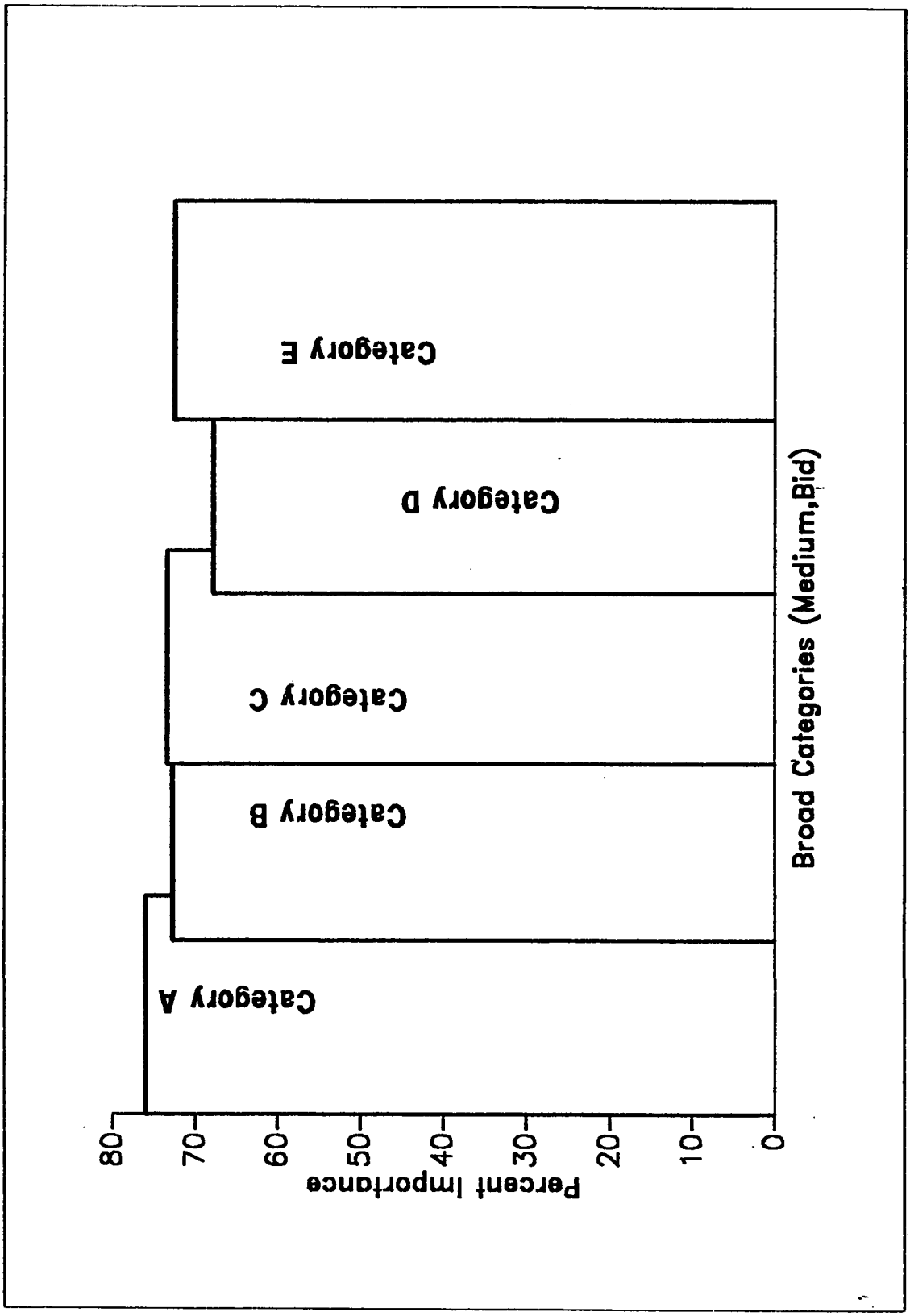

Figure 4: Broad Categories (Medium, Bid)

TABLE 4: Ranked Factors (Large, Bid)

Rank	Factor	Imp.
	A. PROJECT CHARACTERISTICS	75.48
3	Type of equipment required	87.30
11	Project cash flow	80.95
12	Size of contract in SR	79.36
20	Job start time	74.60
26	Location of project	69.84
27	Duration	69.64
29	Owner	66.67
	B. PROJECT DOCUMENTS	76.58
4	Type of contract	85.71
9	Design quality	80.95
23	Designer (A/E)	71.43
28	Owner special requirements	68.25
	C. COMPANY CHARACTERISTICS	75.10
1	Availability of qualified staff	89.28
6	Strength in industry	82.54
7	Uncertainty in cost estimate	82.14
13	Reliability of subcontractors	79.36
14	Availability of required cash	79.36
15	Confidence in work force	79.36
17	Need for work	77.78
18	Past profit in similar jobs	76.19
19	Current work load	76.19
21	Experience in such projects	74.60
24	Establishing long relation with clients	69.84
30	General (office) overhead	66.67
32	Portion subcontracted to others	62.50
34	Public exposure	55.56
	D. BIDDING SITUATION	60.05
10	Time allowed for submitting bids	80.95
25	Required bond capacity	69.84
31	Competition	63.49
35	Bidding document price	50.79
36	Time of bidding (season)	49.21
37	Prequalification requirements	46.03
	E. ECONOMIC SITUATION	76.72
2	Quality of available labor	88.89
5	Risk involved in investment	84.13
8	Availability of labor	80.95
16	Overall economy (availability of work)	77.78
22	Availability of equipment	71.43
33	Governmental division requirements	57.14

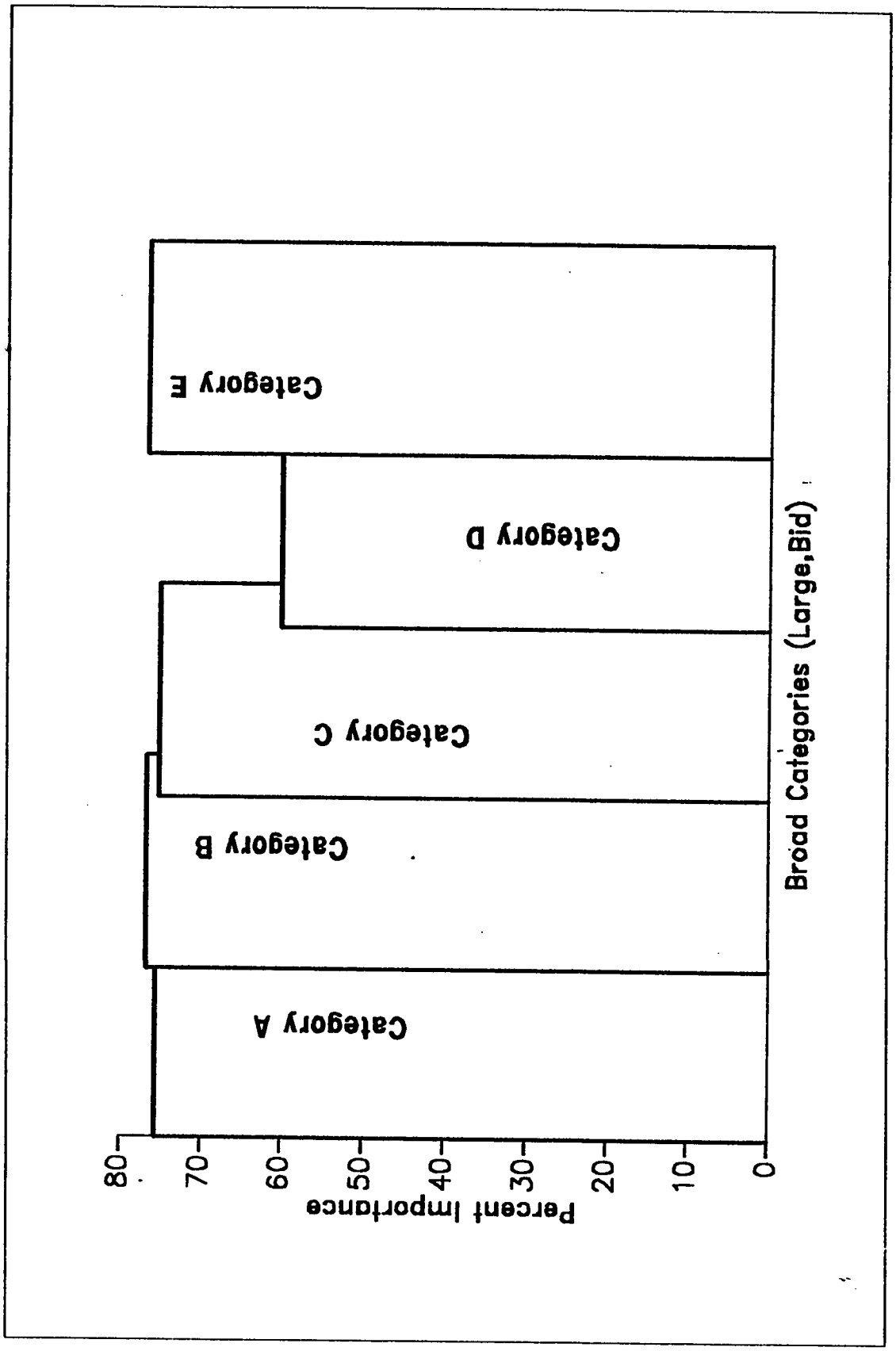

Figure 5: Broad Categories (Large, Bid)

In this study assumptions 1,2,3,4 and 5 are satisfied. However, assumptions 6 and 7 may or may not be satisfied. Still, discriminant analysis can be used because it can be performed when these two assumptions are not satisfied (28).

Examining the results of the discriminant analysis (Appendix III) some conclusions can be drawn as follows:

1)Canonical Correlation for function1=0.905

2)Canonical Correlation for function2=0.872

This means that the degree of association between the three classes (small,medium,large) and the functions (can1 and can2) is very high, which means the classes are different (28). It also means that both canonical functions are powerful discriminators. This is enforced by examining the eigenvalues of both functions (Appendix III). The function with the highest Eigenvalue is the most powerful discriminator (28). Function 1 contributes 58.7% of the discriminating power, while function 2 contributes 41.3%. Thus, both functions are significant and will be used to understand the behavior of the three classes.

3)Square Canonical Correlation for function1=0.82

4)Square Canonical Correlation for function2=0.76

This indicates the proportion of variation in the discriminant functions explained by the groups. This also suggests that the three classes (groups) are different.

Another very important point to check, is whether the groups are really different or that the sampling process produced cases which show the computed degree of discrimination when in fact there are no differences between the groups. This can be resolved by computing the value of 'Wilks's Lambda'. If the value is small, then the discrimination between groups exists, otherwise if lambda approaches 1.0, then no discrimination exists (28).

5)Wilks' Lambda =0.043.

This means that the three groups are different (not due to sampling).

Figure 6 shows a plot of both canonical functions. From studying the figure, it is very clear that the three classes are different. The differences between small and medium are less than those between small and large or medium and large. This is the same result of the correlation coefficients that were introduced earlier.

A very important point is to know what the bases are for these differences. In other words, what are the factors that cause the most discrimination between small, medium, and large contractors?

Two approaches are used to study the discrimination between the groups and identify the most important factors. The first approach utilizes the "Total Canonical Structure". In this approach any factor with a coefficient of 0.3 or more (regardless of the sign) is considered significant. A coefficient of 0.3 is the minimum practical significance level (5). Table 5 shows the total canonical coefficients.

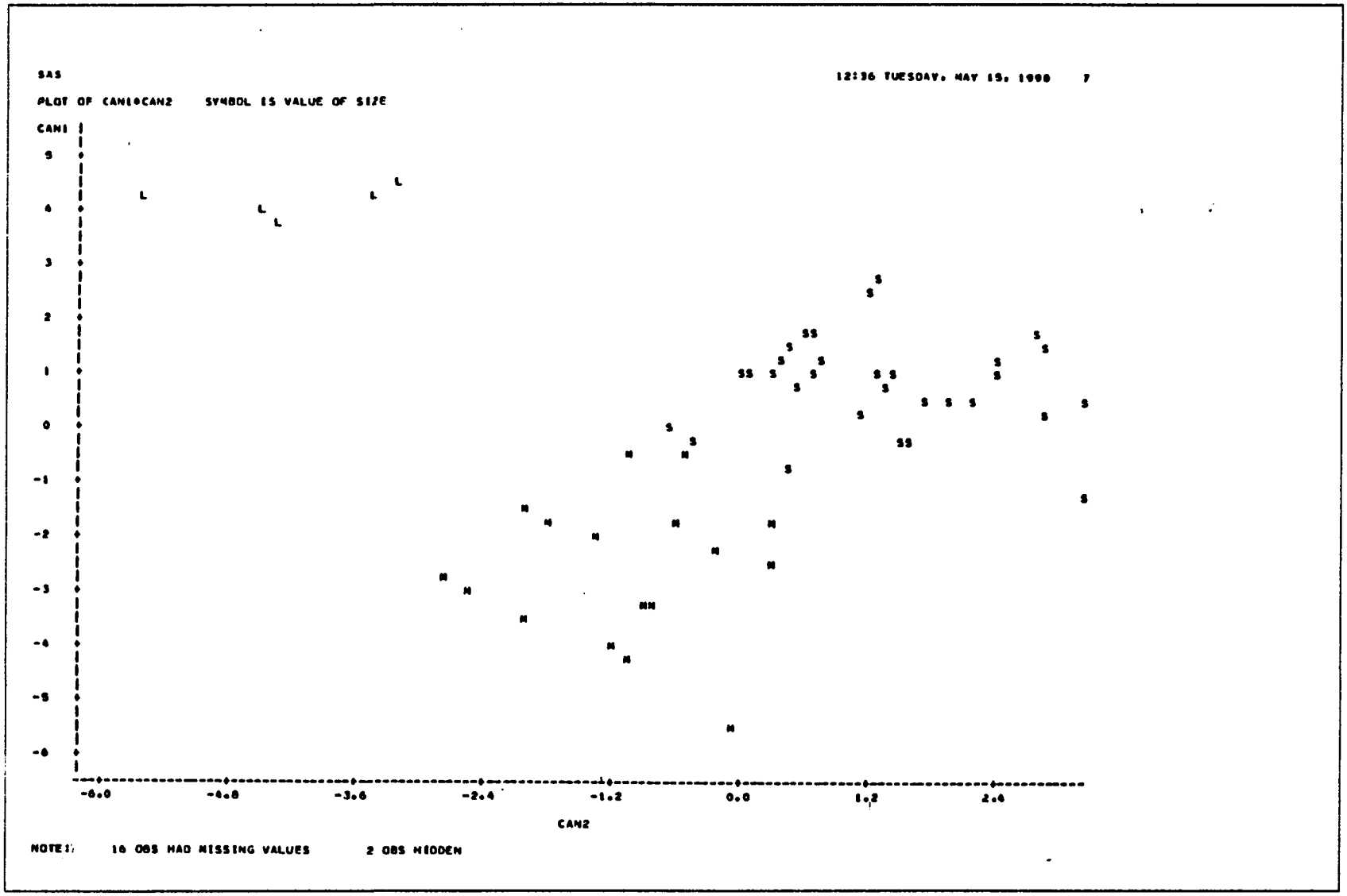

Figure 6: Contractor Size (Business Volume, Bid)

The second approach utilizes the "Standardized Canonical Coefficients". These coefficients give each factor's contribution to the discrimination scores (28). From statistics it is known that the majority of cases are within two standard deviations; anything beyond this limit is considered far. Since these coefficients are expressed in standard deviations, then any factor with a deviation of 2 or more (regardless of sign) is considered a significant discriminator (28). Table 6 shows the standardized canonical coefficients.

TABLE 5: Total Canonical Coefficients (Size, Bid)

Factors	Can1.	Can2.
Size of contract in SR	+0.030	-0.134
Type of contract	+0.159	+0.096
Duration	+0.299	+0.183
Location of project	+0.125	+0.236
Job start time	+0.037	+0.244
Portion subcontracted to others	+0.013	+0.067
Reliability of subcontractors	+0.160	+0.212
Availability of qualified staff	+0.337	+0.304
Availability of labor	+0.310	+0.332
Quality of available labor	+0.275	+0.208
Availability of equipment	+0.256	+0.209
Type of equipment required	+0.255	+0.111
Owner	+0.178	+0.115
Designer (A/E)	+0.258	+0.261
Design quality	+0.239	+0.238
Uncertainty in cost estimate	-0.060	+0.027
Past profit in similar jobs	+0.169	+0.064
General (office) overhead	+0.119	+0.124
Time of bidding (season)	-0.007	+0.350
Availability of required cash	+0.154	+0.065
Risk involved in investment	-0.038	+0.087
Competition	+0.067	+0.123
Strength in industry	+0.275	+0.062
Overall economy (availability of work)	+0.280	+0.005
Need for work	+0.132	+0.070
Current work load	+0.126	+0.094
Confidence in work force	+0.300	+0.199
Project cash flow	+0.319	+0.219
Time allowed for submitting bids	+0.365	+0.165
Establishing long relation with clients	+0.503	+0.378
Public exposure	+0.204	+0.360
Required bond capacity	+0.231	+0.319
Experience in such projects	+0.239	+0.258
Owner special requirements	+0.101	+0.046
Prequalification requirements	-0.029	+0.213
Bidding document price	-0.174	+0.432
Governmental division requirements	+0.042	+0.424

TABLE 6: Standardized Canonical Coefficients (Size, Bid)

Factors	Can1.	Can2.
Size of contract in SR	+0.088	-0.802
Type of contract	-1.726	+0.417
Duration	+2.052	-0.331
Location of project	-0.328	+0.653
Job start time	-1.908	-0.293
Portion subcontracted to others	+0.934	-0.302
Reliability of subcontractors	-0.302	+0.640
Availability of qualified staff	+2.407	+1.567
Availability of labor	-1.004	+0.502
Quality of available labor	-1.116	-2.996
Availability of equipment	+1.412	+1.922
Type of equipment required	+1.031	-2.192
Owner	-0.014	+0.702
Designer (A/E)	+0.440	-0.177
Design quality	+0.618	-0.654
Uncertainty in cost estimate	-1.041	+0.189
Past profit in similar jobs	-1.000	+0.119
General (office) overhead	+0.119	-0.757
Time of bidding (season)	-1.325	+1.846
Availability of required cash	+1.450	+0.398
Risk involved in investment	+0.112	-0.677
Competition	+0.238	-0.489
Strength in industry	-1.171	+0.465
Overall economy (availability of work)	-0.762	-1.031
Need for work	-0.724	-1.278
Current work load	+0.101	+0.886
Confidence in work force	-0.460	+1.135
Project cash flow	-0.169	+0.020
Time allowed for submitting bids	+1.012	-0.789
Establishing long relation with clients	+2.793	+0.546
Public exposure	+0.338	+0.828
Required bond capacity	-0.553	+0.477
Experience in such projects	-1.361	+0.250
Owner special requirements	+0.473	-2.045
Prequalification requirements	-1.692	+1.206
Bidding document price	-1.114	+0.108
Governmental division requirements	+0.389	+0.341

The first approach determines the degree of association between a variable and the canonical function (28). The first function is significantly related to 6 variables. These are availability of qualified staff, availability of labor, confidence in work force, project cash

flow, time allowed for submitting bids, and establishing long term relations with clients.

The meaning of function 1 is not clear; the variables to which it is related do not specifically measure the same thing. In general, it seems that the variables are more related to the characteristics of the company.

The second canonical function is significantly related to availability of labor, availability of qualified staff, time of bidding (season), establishing long term relations with clients, public exposure, required bond capacity, bidding document price, and government division requirements. Function 2 seems to be more related to the economic and bidding situation.

Reviewing the standardized Canonical coefficients (Table 6), the variables that cause the most discrimination are the duration of the project, availability of qualified staff, quality of available labor, type of equipment required, establishing long term relations with clients, and owner special requirements.

1. Duration of Project

It is logical that the duration of the project discriminates between small, medium, and large contractors. In general, the bigger the project the longer the duration. Accordingly, small contractors usually handle projects that are shorter in duration than medium or large contractors do.

2. Availability of Qualified Staff

Availability of qualified staff increases in importance as the size of the contractor increases. Thus, qualified staff are more important for large contractors than for small or medium. This makes sense because the larger the contractor the bigger and more complicated the projects handled. More complicated projects require more qualified staff.

3. Quality of Available Labor and Type of Equipment Required

Quality of available labor and type of equipment required decrease in importance as the size of the contractor increases. This is evident from the negative sign of the coefficients. This may be due to the fact that small contractors do not maintain enough resources to meet the job requirements, while large contractors have their own qualified labors and the required equipment.

4. Establishing Long Term Relations with Clients

Establishing long term relations with clients increase in importance as the size of the contractor increases. This may be due to the difference in the planning period. Large contractors may plan ahead for 15 years, while small contractors may plan for the coming month or year. This situation encourages large contractors to maintain good relationships with clients so as to secure their operation during the planned period.

5. Owner's Special Requirements

Owner's special requirements decreases in importance as the size increases. This may be due to the abilities of the contractors. Small contractors may be stuck with special requirements which they do not have the resources or the capabilities to perform. This situation may not be true for large contractors.

In general, the differences between the three classes are mainly due to the company characteristics, and the economic and bidding situation.

At this stage it is possible to use other variables to classify contractors. The 37 factors are ranked using the importance index; in accordance to the new classification. The ranking shows if the importance of the factors changes from one class to another. Then discriminant analysis is used to make sure that the classification is legitimate and to identify the basis for the discrimination between the different classes.

Contractors are classified into "Good" bidders and "Bad" bidders. "Good" bidders are defined as these who in their latest 10 bids:

1. Won 5 times or more.
2. And finished within time 5 times or more.
3. And finished within cost 5 times or more.
4. And regretted bidding one time or less.

Bad bidders are the flip side of the coin. The results show that 30.4% of the firms won 5 times or more, 29% were the lowest bidders 5 times or more, 19.1% finished within time 5 times or more, 18.8% finished within estimated cost 5 times or more, and 89% regretted bidding 1 time or less. Good bidders constituted only 18.8% (13 firms), while the majority were classified as bad bidders.

Studying tables 7 and 8, almost all of the 37 factors are considered important for both good and bad bidders. Although the rankings change, the differences in the importance are really not significant.

Figures 7 and 8 show that the same behavior is repeated by the broad categories. These results suggest that there is no significant difference in behavior between good and bad bidders.

TABLE 7: Ranked Factors (Good, Bid)

Rank	Factor	Imp.
	A. PROJECT CHARACTERISTICS	77.50
9	Size of contract in SR	85.71
12	Location of project	84.28
15	Project cash flow	82.86
20	Owner	80.00
24	Type of equipment required	77.14
34	Job start time	68.25
36	Duration	64.28
	B. PROJECT DOCUMENTS	85.91
1	Type of contract	94.28
2	Design quality	93.65
13	Designer (A/E)	84.28
32	Owner special requirements	71.43
	C. COMPANY CHARACTERISTICS	79.78
3	Reliability of subcontractors	92.06
4	Availability of required cash	91.42
6	Availability of qualified staff	88.89
8	Establishing long relation with clients	87.14
10	Need for work	85.71
14	Uncertainty in cost estimate	84.12
16	Experience in such projects	82.86
19	Confidence in work force	81.42
21	Strength in industry	80.00
26	Public exposure	77.14
27	Current work load	76.19
28	Past profit in similar jobs	75.71
31	General (office) overhead	71.43
37	Portion subcontracted to others	42.86
	D. BIDDING SITUATION	76.90
11	Required bond capacity	85.71
17	Bidding document price	82.86
22	Competition	78.57
23	Time allowed for submitting bids	78.57
33	Time of bidding (season)	68.57
35	Prequalification requirements	67.14
	E. ECONOMIC SITUATION	80.12
5	Governmental division requirements	89.28
7	Risk involved in investment	88.57
18	Quality of available labor	81.42
25	Overall economy (availability of work)	77.14
29	Availability of equipment	72.86
30	Availability of labor	71.43

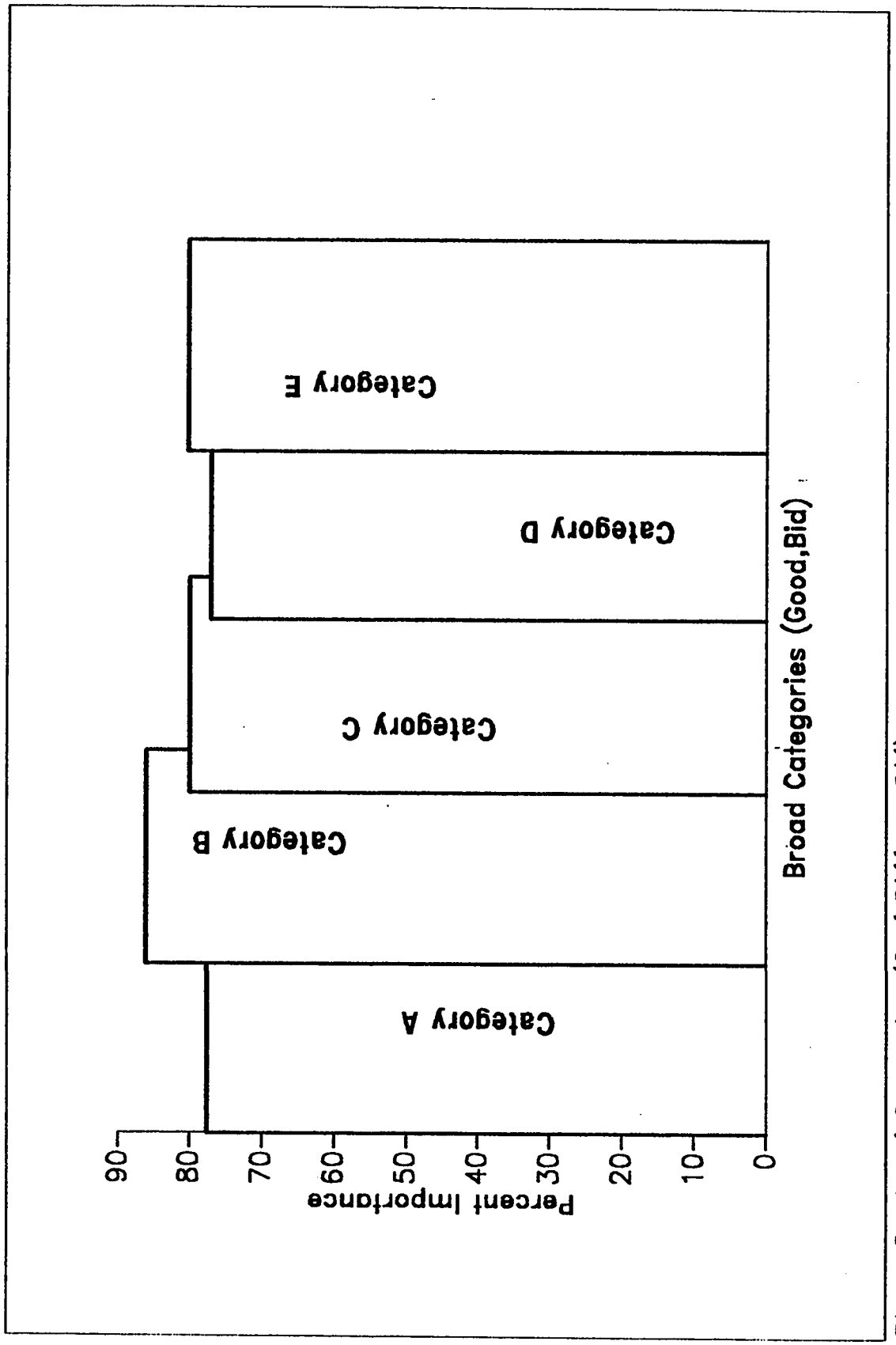

Figure 7: Broad Categories (Good Bidders, Bid)

TABLE 8: Ranked Factors (Bad, Bid)

Rank	Factor	Imp.
	A. PROJECT CHARACTERISTICS	79.68
1	Project cash flow	88.81
7	Size of contract in SR	82.67
12	Location of project	80.79
15	Type of equipment required	79.39
18	Owner	78.45
25	Duration	75.48
31	Job start time	72.17
	B. PROJECT DOCUMENTS	76.78
4	Type of contract	85.01
24	Design quality	75.71
28	Owner special requirements	73.57
30	Designer (A/E)	72.83
	C. COMPANY CHARACTERISTICS	77.79
2	Availability of required cash	86.18
3	Availability of qualified staff	85.71
5	Experience in such projects	83.81
6	Confidence in work force	82.67
9	Need for work	81.90
11	Establishing long relation with clients	80.95
13	Strength in industry	80.79
16	Current work load	79.18
17	Past profit in similar jobs	78.57
20	Uncertainty in cost estimate	77.97
26	Reliability of subcontractors	74.00
32	General (office) overhead	70.49
35	Public exposure	67.62
37	Portion subcontracted to others	59.28
	D. BIDDING SITUATION	72.09
19	Competition	78.45
21	Time allowed for submitting bids	77.38
27	Required bond capacity	73.85
33	Bidding document price	69.05
34	Prequalification requirements	68.09
36	Time of bidding (season)	65.71
	E. ECONOMIC SITUATION	78.55
8	Overall economy (availability of work)	82.20
10	Availability of labor	81.49
14	Quality of available labor	80.56
22	Availability of equipment	77.28
23	Risk involved in investment	76.90
29	Governmental division requirements	72.88

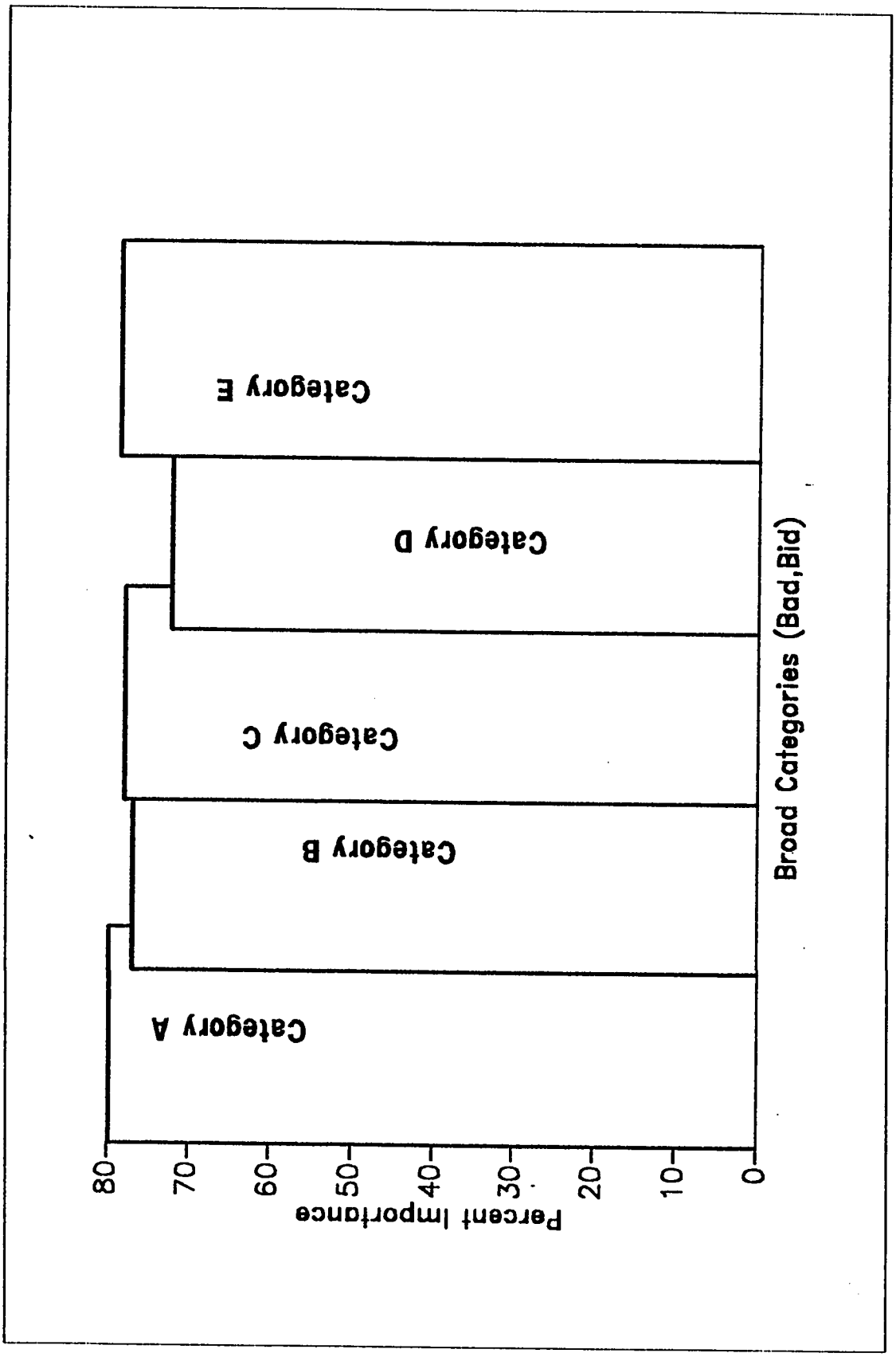

Figure 8: Broad Categories (Bad Bidders, Bid)

A Pearson correlation coefficient of 0.43 suggests that differences exist. Discriminant analysis was used to test if differences exist or not.

Since there are only two groups, only one canonical function is produced. This function is significant and it is the most powerful discriminator. A canonical correlation of 0.909 and a squared Canonical correlation of 0.830 suggest that good and bad bidders are different (Appendix III). Examination of the class means (centroids) of both classes reveals that good and bad are different. The centroid of bad bidders is -0.68, while that of good bidders is +6.77. A Wilks' lambda of 0.17 suggests that the discrimination is real and not due to sampling error.

Trying to understand the dimension which causes the discrimination between good and bad bidders, table 9 is reviewed. The significant variables,i.e. with coefficient > 0.3, are size of contract, type of contract, portion subcontracted to others, designer(A/E), design quality, and government division requirements. The underlying dimension of the function seems to be related to the project documents.

TABLE 9: Total Canonical Coefficients (Good & Bad, Bid)

Factors	Can1.
Size of contract in SR	+0.361
Type of contract	+0.306
Duration	+0.055
Location of project	+0.166
Job start time	-0.085
Portion subcontracted to others	-0.330
Reliability of subcontractors	+0.283
Availability of qualified staff	+0.157
Availability of labor	+0.040
Quality of available labor	+0.161
Availability of equipment	+0.222
Type of equipment required	+0.179
Owner	+0.165
Designer (A/E)	+0.325
Design quality	+0.316
Uncertainty in cost estimate	+0.208
Past profit in similar jobs	-0.060
General (office) overhead	+0.041
Time of bidding (season)	+0.058
Availability of required cash	+0.159
Risk involved in investment	+0.234
Competition	+0.097
Strength in industry	+0.129
Overall economy (availability of work)	+0.111
Need for work	+0.032
Current work load	+0.011
Confidence in work force	+0.192
Project cash flow	+0.116
Time allowed for submitting bids	+0.285
Establishing long relation with clients	+0.214
Public exposure	+0.133
Required bond capacity	+0.252
Experience in such projects	+0.144
Owner special requirements	+0.196
Prequalification requirements	+0.147
Bidding document price	+0.141
Governmental division requirements	+0.382

1. Size of Contract

As the size of the contract increases the degree of discrimination between good and bad bidders increases. This may be due to the fact that good bidders will not get involved in a project beyond their capabilities.

2. Type of Contract

This variable discriminates between good and bad bidders. Different projects with different characteristics and different risk levels introduce different types of contracts. Good bidders are expected to appreciate more the relation between type of project, risk involved, and type of contract required.

3. Government Division Requirements

Some government divisions have certain requirements that must be satisfied. These requirements may turn out to be very expensive and thus good bidders must know all the parties involved, government divisions, in the project and know the extent of their requirements.

Reviewing table 10 (standardized canonical coefficients), the variables that cause the most discrimination are portion subcontracted to others, reliability of subcontractors, design quality, and public exposure.

1. Portion Subcontracted to Others

As the portion subcontracted to others increases, the degree of discrimination between good and bad bidders decreases.

2. Reliability of Subcontractors

As the reliability of subcontractors increases the degree of discrimination between good and bad bidders increases. Combining this with the previous variable, it is logical that good bidders will not subcontract except to reliable subcontractors.

3. Design Quality

As the design quality improves, the degree of discrimination between good and bad bidders increases. It is expected that good bidders are more concerned about the quality of the design. Another interpretation is that good bidders do not bid unless they know exactly what is expected from them. A quality design and specifications help good bidders in their decision.

4. Public Exposure

As public exposure becomes more important, the discrimination between both classes increases. Good bidders are expected to be more concerned with public exposure (advertising).

TABLE 10: Standardized Canonical Coefficients
(Good & Bad, Bid)

Factors	Can1.
Size of contract in SR	+1.068
Type of contract	-0.241
Duration	+0.303
Location of project	+1.094
Job start time	-0.112
Portion subcontracted to others	-2.091
Reliability of subcontractors	+2.120
Availability of qualified staff	-1.449
Availability of labor	+0.917
Quality of available labor	+0.315
Availability of equipment	+0.182
Type of equipment required	+1.328
Owner	+0.219
Designer (A/E)	-0.842
Design quality	+2.126
Uncertainty in cost estimate	+0.908
Past profit in similar jobs	-0.401
General (office) overhead	-0.185
Time of bidding (season)	-1.395
Availability of required cash	-1.082
Risk involved in investment	+0.422
Competition	-0.453
Strength in industry	-0.649
Overall economy (availability of work)	+0.121
Need for work	+0.195
Current work load	-0.662
Confidence in work force	+0.454
Project cash flow	-0.123
Time allowed for submitting bids	-0.016
Establishing long relation with clients	+1.258
Public exposure	-2.416
Required bond capacity	-0.331
Experience in such projects	-0.475
Owner special requirements	-0.255
Prequalification requirements	+0.921
Bidding document price	+0.677
Governmental division requirements	+0.041

Chapter 5

MARKUP SIZE DECISION

The second major decision to be made by any contractor is the selection of the appropriate markup size to be added to the project cost.

In this chapter the factors that influence the outcome of the markup size decision are introduced.

5.1 Factors Affecting the Size of Markup

Contractors who decide to bid on a project prepare cost estimates. An interested contractor studies the bidding documents and estimates the project direct and indirect costs.

Direct costs include all costs that are directly related to cost items of the project. However, costs are not known for certain, so uncertainty in cost items is the usual case. Contractors usually try to take care of this unfortunate situation by adjusting markups or by other means.

In the local construction industry, 36.8% of the contractors apply a correction factor, 41.2% adjust their markups, and 22% do not consider it at all.

Indirect costs include all costs that are necessary to perform the job but not directly related to a particular project. Costs such as office overhead and job related contingencies are some examples of indirect costs. These costs must be recovered; a means by which to recover such costs is to adjust the markup.

The study revealed that, 46.4% of the local firms include office overhead in markup, 23.2% charge it as a cost item, and 30.4% do either depending on the project.

Job related contingencies are handled in the same manner. Thirty seven percent of the firms include it in markup, 22.4% charge it as a cost item, 37.3% do either depending on the project, and 3% take other precautions.

Markup size is set by top management. When deciding on the proper markup size, management realizes that the right size is a function of many factors. Table 11 embodies 37 factors that are thought to be of influence on the markup size.

TABLE 11: Rank of all the contractors

Rank	Factor	Imp.
	A. PROJECT CHARACTERISTICS	75.02
1	Size of contract in SR	81.51
4	Duration	78.23
7	Project cash flow	76.96
10	Type of equipment required	75.11
12	Location of project	74.47
20	Owner	72.56
30	Job start time	66.34
	B. PROJECT DOCUMENTS	72.64
3	Type of contract	79.69
21	Design quality	72.15
22	Owner special requirements	71.66
28	Designer (A/E)	67.05
	C. COMPANY CHARACTERISTICS	71.64
2	Availability of required cash	80.41
5	Uncertainty in cost estimate	77.52
9	Confidence in work force	75.28
11	Strength in industry	74.71
13	Availability of qualified staff	73.66
14	Need for work	73.04
15	Experience in such projects	73.04
17	Establishing long relation with clients	72.83
19	Past profit in similar jobs	72.58
24	General (office) overhead	70.71
26	Current work load	69.79
29	Reliability of subcontractors	66.59
32	Portion subcontracted to others	63.26
35	Public exposure	59.56
	D. BIDDING SITUATION	64.12
16	Required bond capacity	72.88
25	Competition	70.51
33	Time allowed for submitting bids	63.13
34	Time of bidding (season)	61.75
36	Bidding document price	58.37
37	Prequalification requirements	58.11
	E. ECONOMIC SITUATION	71.86
6	Risk involved in investment	77.09
8	Availability of equipment	75.28
18	Overall economy (availability of work)	72.79
23	Quality of available labor	70.98
27	Availability of labor	68.93
31	Governmental division requirements	66.07

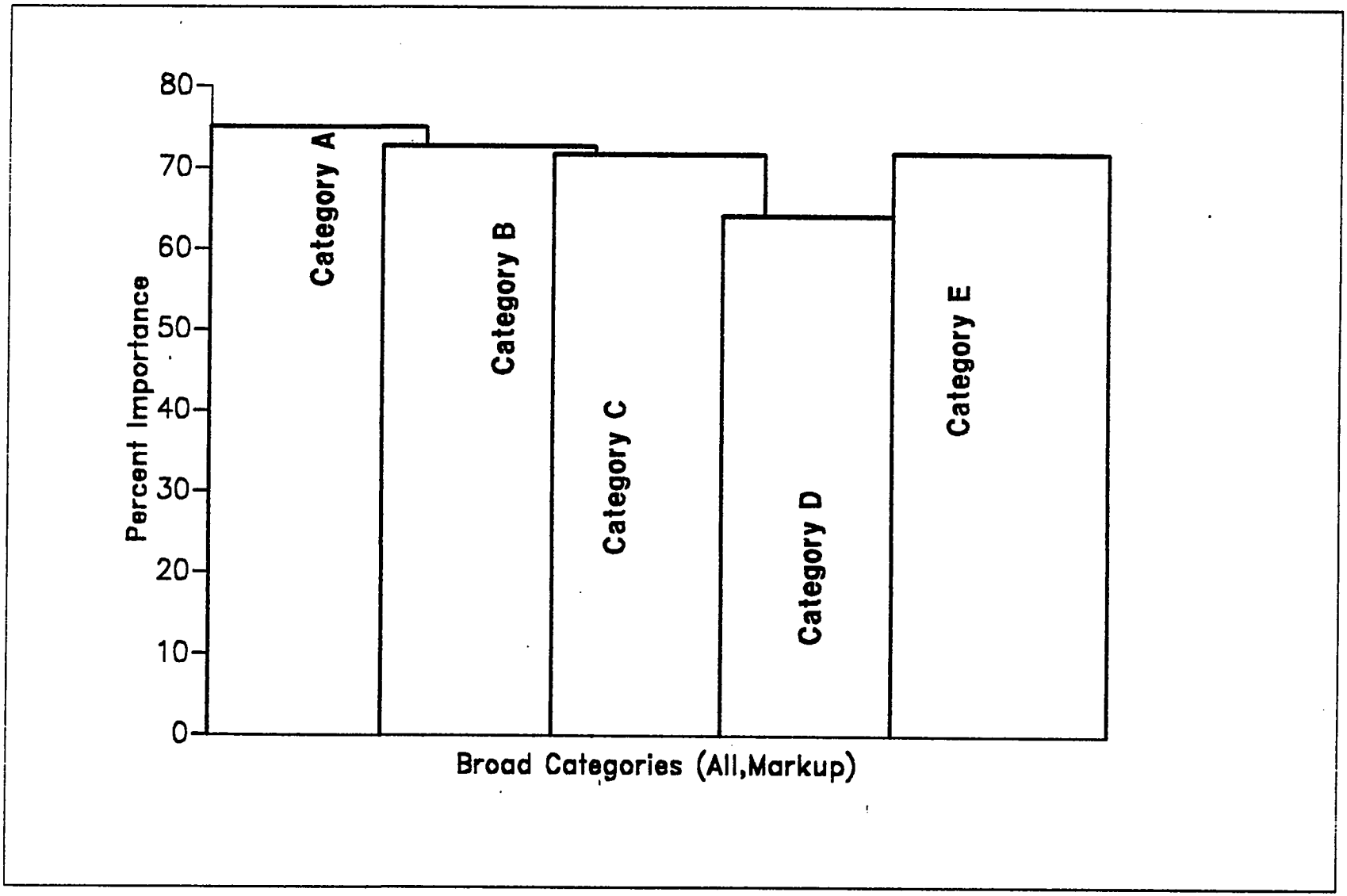

Figure 9: Broad Categories (All Contractors, Markup)

Reviewing table 11 and figure 9, all the 37 factors and the five broad categories are important to all the contractors. The differences in importance are not significant. This behavior may change as the contractor size changes from small to medium to large. Tables 12, 13 and 14 show the ranking and importance of the 37 factors as considered by the three contractor sizes. Figures 10, 11 and 12 present the behavior of the broad categories for the three classes.

TABLE 12: Ranked Factors (Markup, Small)

Rank	Factor	Imp.
	A. PROJECT CHARACTERISTICS	77.68
1	Size of contract in SR	83.83
3	Location of project	81.62
5	Duration	78.97
9	Project cash flow	77.31
12	Type of equipment required	75.92
16	Owner	75.10
25	Job start time	70.98
	B. PROJECT DOCUMENTS	73.77
4	Type of contract	81.35
19	Design quality	73.73
24	Owner special requirements	71.01
30	Designer (A/E)	68.98
	C. COMPANY CHARACTERISTICS	73.02
2	Availability of required cash	82.85
6	Establishing long relation with clients	78.57
8	Availability of qualified staff	77.38
11	Confidence in work force	76.73
13	Strength in industry	75.92
17	Uncertainty in cost estimate	74.89
18	Experience in such projects	74.79
20	Past profit in similar jobs	73.06
26	Need for work	70.61
27	General (office) overhead	70.56
29	Reliability of subcontractors	68.98
31	Current work load	68.91
33	Public exposure	66.52
37	Portion subcontracted to others	62.45
	D. BIDDING SITUATION	68.50
14	Competition	75.51
15	Required bond capacity	75.45
28	Time of bidding (season)	69.79
34	Prequalification requirements	63.84
35	Bidding document price	63.59
36	Time allowed for submitting bids	62.86
	E. ECONOMIC SITUATION	73.66
7	Availability of equipment	78.17
10	Risk involved in investment	77.14
21	Overall economy (availability of work)	73.06
22	Availability of labor	72.62
23	Quality of available labor	72.22
32	Governmental division requirements	68.75

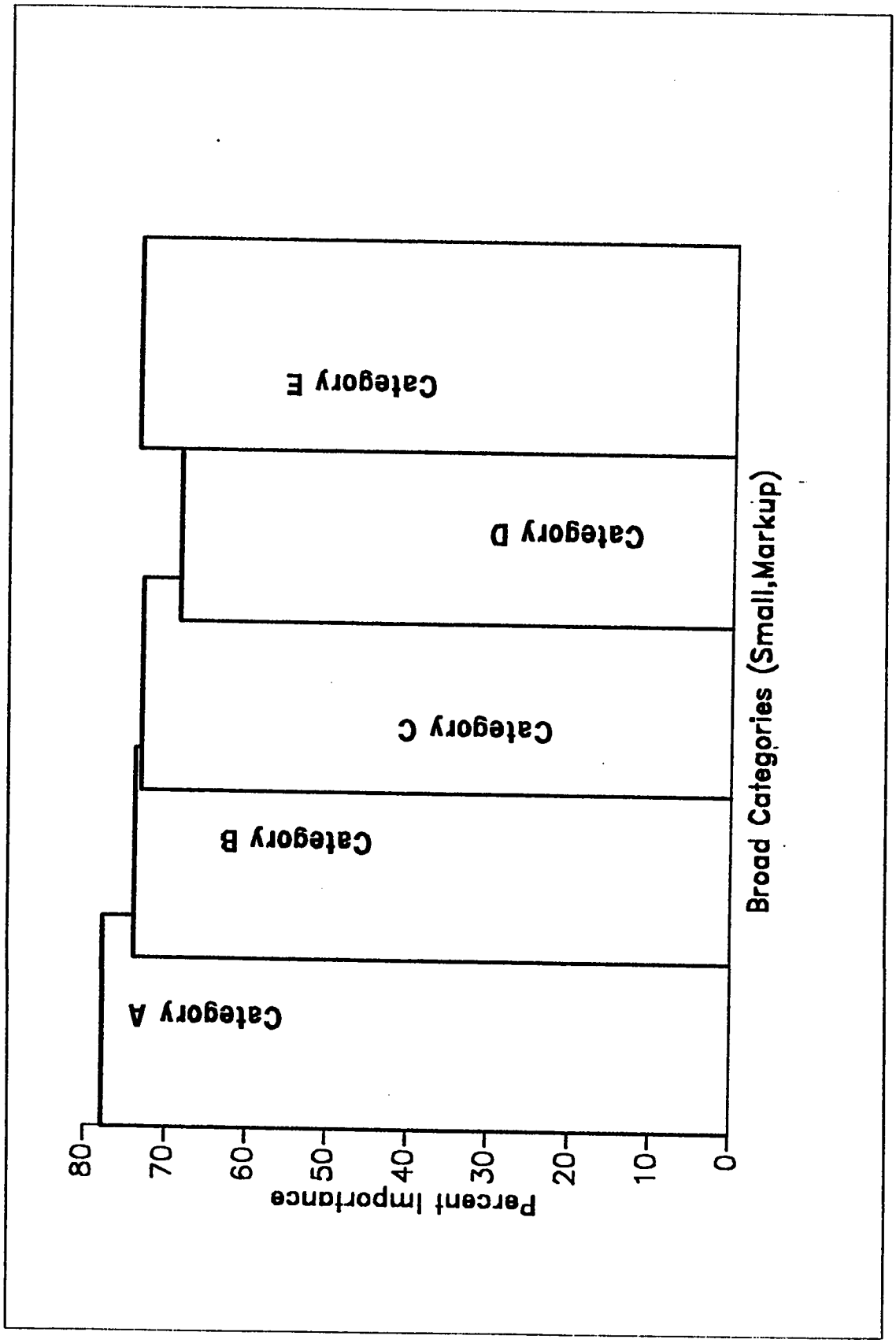

Figure 10: Broad Categories (Small, Markup)

TABLE 13: Ranked Factors (Markup, Medium)

Rank	Factor	Imp.
	A. PROJECT CHARACTERISTICS	71.99
2	Project cash flow	80.00
4	Size of contract in SR	78.91
7	Duration	76.69
15	Type of equipment required	72.18
18	Owner	72.14
26	Location of project	65.41
32	Job start time	58.64
	B. PROJECT DOCUMENTS	71.05
5	Owner special requirements	78.19
9	Type of contract	75.00
22	Design quality	67.86
29	Designer (A/E)	63.16
	C. COMPANY CHARACTERISTICS	69.66
1	Availability of required cash	80.45
3	Uncertainty in cost estimate	79.28
6	Need for work	77.44
8	Experience in such projects	75.71
10	Confidence in work force	74.28
14	Strength in industry	72.22
16	Past profit in similar jobs	72.18
17	General (office) overhead	72.18
20	Current work load	69.92
25	Availability of qualified staff	66.42
27	Establishing long relation with clients	64.66
30	Reliability of subcontractors	60.15
31	Portion subcontracted to others	60.00
37	Public exposure	50.38
	D. BIDDING SITUATION	58.89
19	Required bond capacity	71.42
24	Competition	66.92
33	Time allowed for submitting bids	57.14
34	Bidding document price	52.63
35	Time of bidding (season)	52.63
36	Prequalification requirements	52.63
	E. ECONOMIC SITUATION	69.98
11	Availability of equipment	73.68
12	Overall economy (availability of work)	73.57
13	Risk involved in investment	72.93
21	Governmental division requirements	68.25
23	Quality of available labor	67.14
28	Availability of labor	64.28

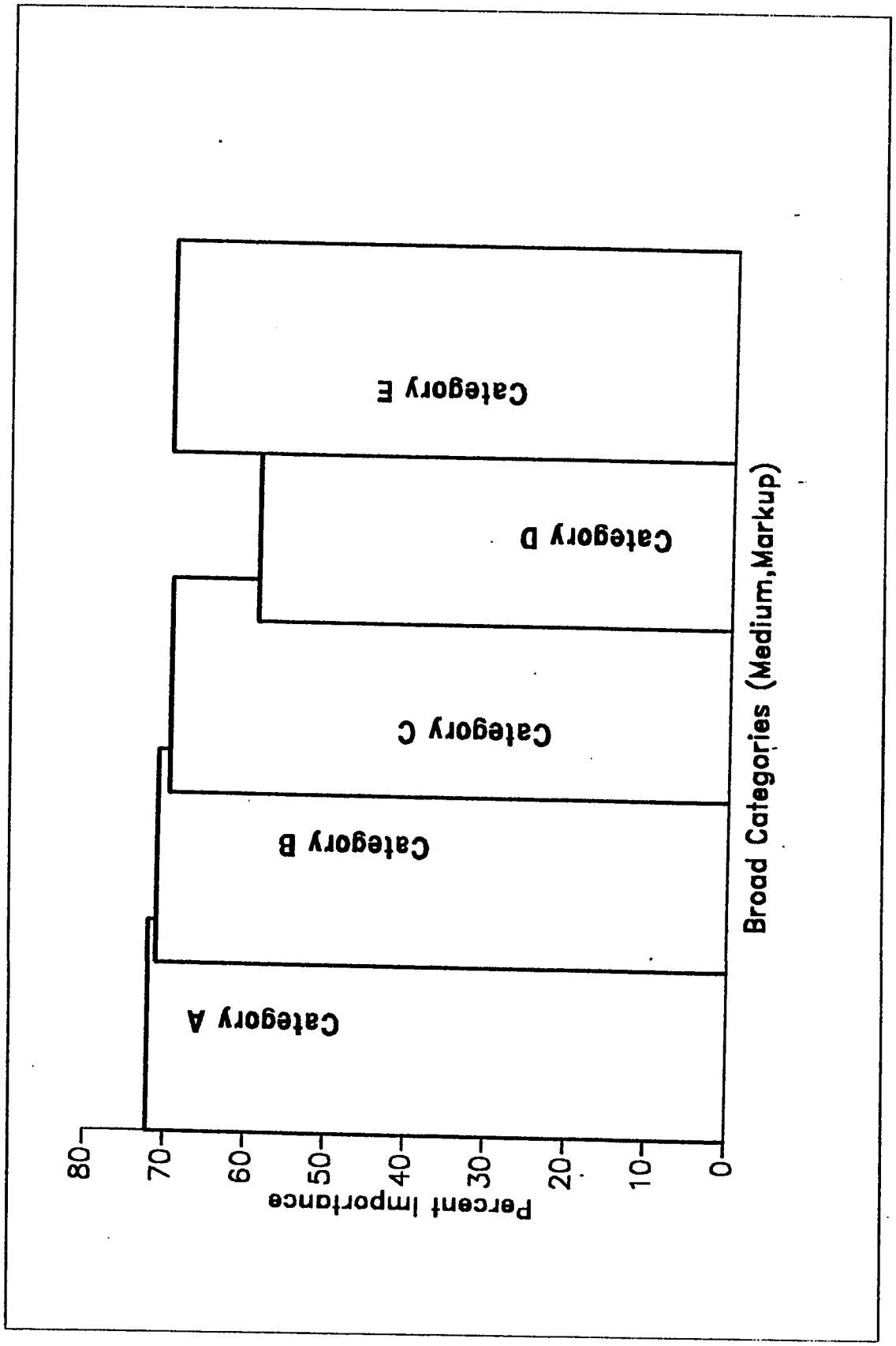

Figure 11: Broad Categories (Medium, Markup)

TABLE 14: Ranked Factors (Markup, Large)

Rank	Factor	Imp.
	A. PROJECT CHARACTERISTICS	70.66
4	Duration	78.57
5	Type of equipment required	78.57
7	Size of contract in SR	77.78
22	Project cash flow	67.86
24	Job start time	66.07
27	Location of project	63.26
29	Owner	62.50
	B. PROJECT DOCUMENTS	71.88
2	Type of contract	83.93
8	Design quality	76.78
20	Designer (A/E)	67.86
31	Owner special requirements	58.93
	C. COMPANY CHARACTERISTICS	70.53
3	Uncertainty in cost estimate	83.93
9	Portion subcontracted to others	75.00
10	Availability of qualified staff	75.00
12	Strength in industry	75.00
13	Need for work	73.21
14	Current work load	73.21
15	Reliability of subcontractors	71.43
16	Past profit in similar jobs	71.43
17	Confidence in work force	71.43
18	Availability of required cash	69.64
21	General (office) overhead	67.86
23	Establishing long relation with clients	67.86
30	Experience in such projects	58.93
33	Public exposure	53.57
	D. BIDDING SITUATION	58.33
6	Time allowed for submitting bids	78.57
26	Required bond capacity	66.07
32	Competition	57.14
34	Bidding document price	51.78
35	Time of bidding (season)	48.21
36	Prequalification requirements	48.21
	E. ECONOMIC SITUATION	67.48
1	Risk involved in investment	85.71
11	Quality of available labor	75.00
19	Overall economy (availability of work)	69.64
25	Availability of equipment	66.07
28	Availability of labor	63.26
37	Governmental division requirements	45.24

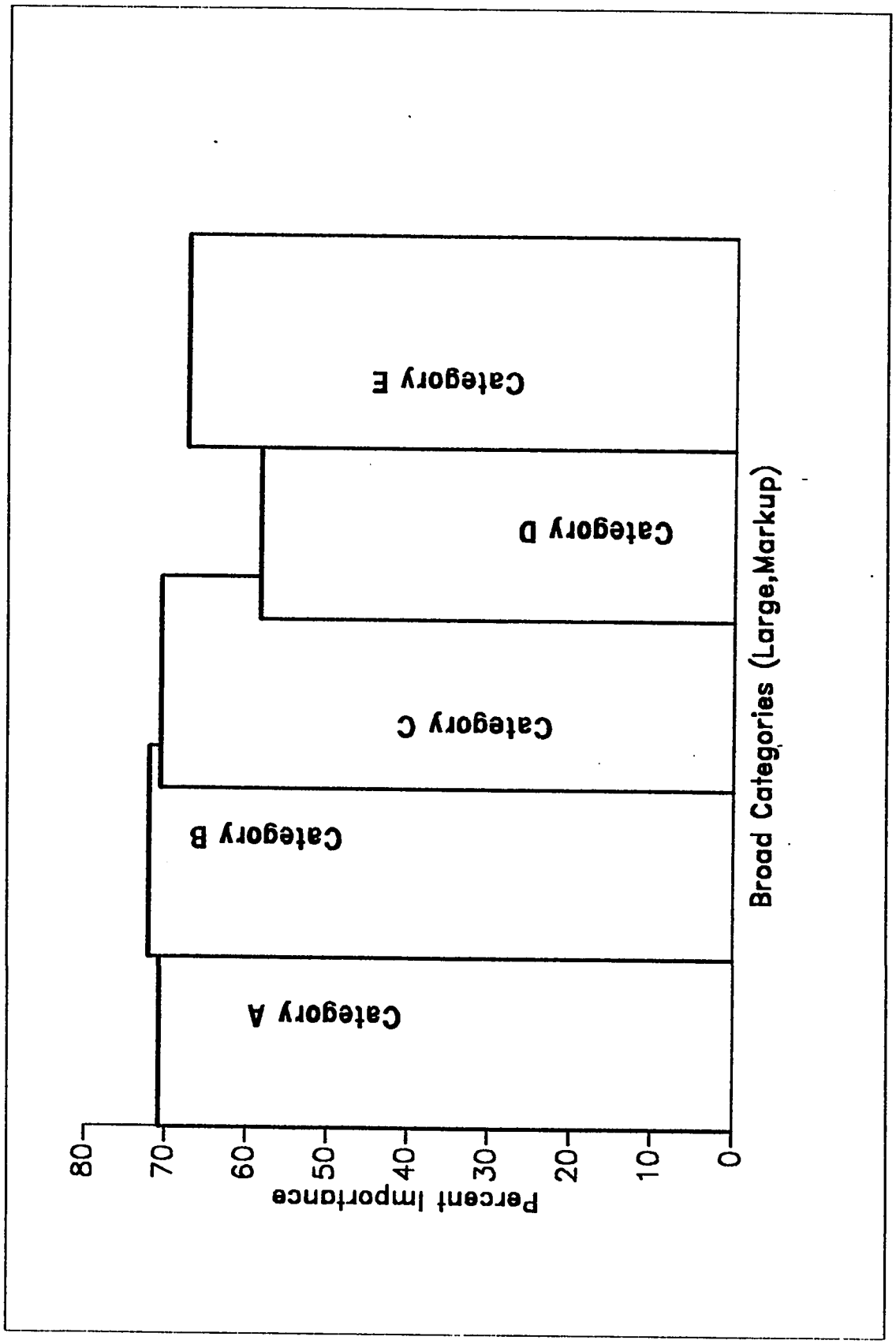

Figure 12: Broad Categories (Large, Markup)

Small, medium, and large contractors seem to behave similarly regarding the 37 factors and the five broad categories.

Pearson correlation coefficients help in understanding the relations between the three classes. Small and medium have a correlation coefficient of 0.62 which suggests that they have much in common; small and large have a coefficient of 0.33 which means they are not similar; a coefficient of 0.38 between medium and large indicates that they do not have much in common. These coefficients give the impression that the three classes are different.

Discriminant analysis was used to decide if the importance index is correct and that no differences exist between the three classes, or that the correlation coefficients are more accurate and differences do exist. Discriminant analysis also helps identify the underlying dimensions of discrimination.

Two canonical functions are produced as the discriminators between the classes. Both functions are significant and are used in understanding the discrimination basis. Function 1 contributes to 65.4% of the discrimination power, while function 2 contributes to 34.6%.

The high canonical correlation coefficients (0.94,0.91) and the squared canonical coefficients (0.89,0.82) suggest that both functions are powerful and the three classes are discriminated. A Wilks' lambda of 0.018 suggests that discrimination exists and it is not due to sampling error.

Figure 13 shows a plot of both Canonical functions. It shows the three classes of contractors. It is clear that small, medium, and large are separate and thus they behave differently, making their classification legitimate.

Reviewing table 15 (total canonical structure coefficients), the significant variables are location of project, job start time, time of bidding (season), and need for work. These variables are related to function 1. There is no single characteristic that the variables are measuring and thus the meaning of function 1 is not clear.

The variables related to function 2 are time allowed for submitting bids, and government divisions regulations. Interpreting this function's dimension is not clear.

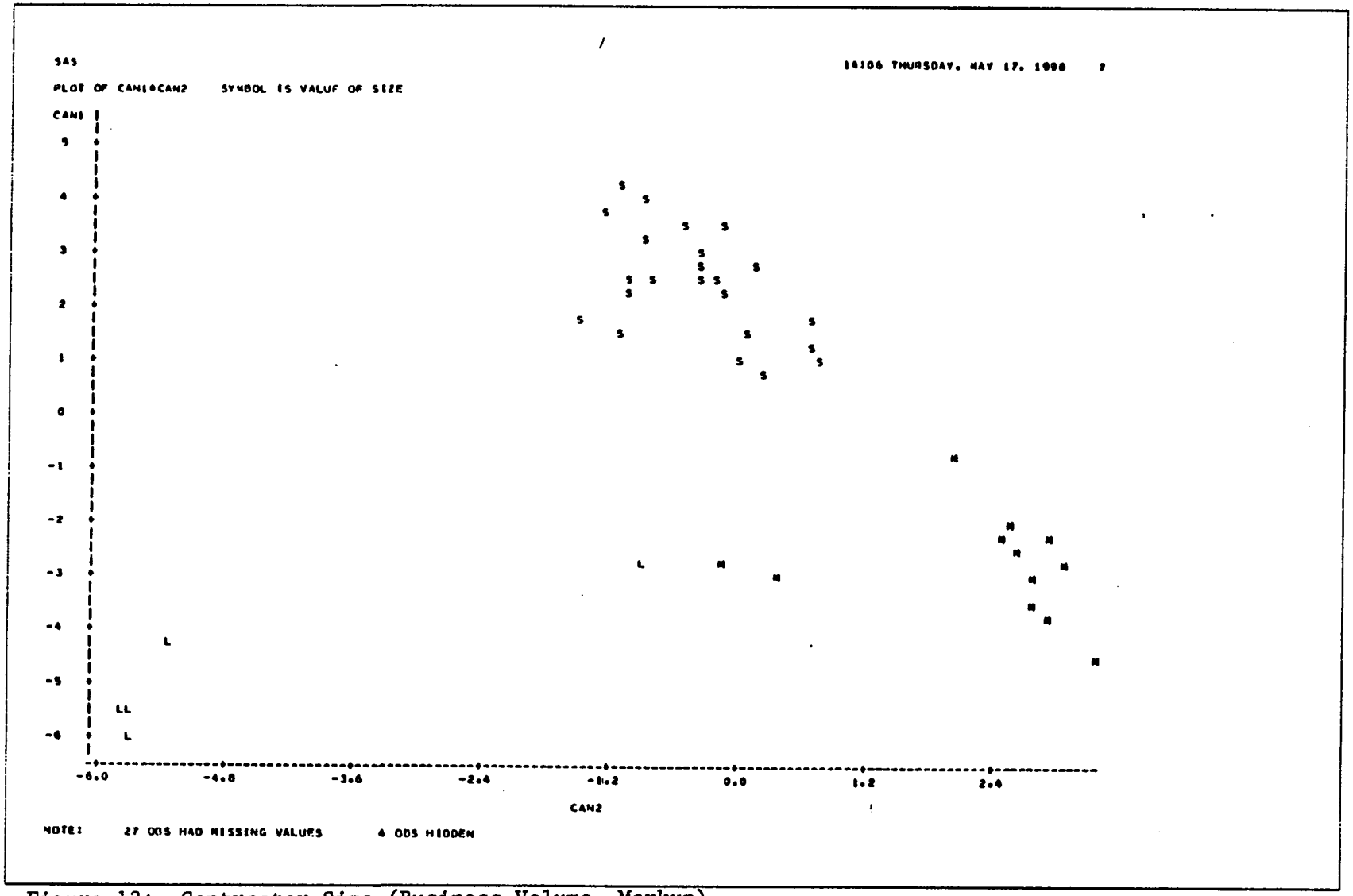

Figure 13: Contractor Size (Business Volume, Markup)

TABLE 15: Total Canonical Coefficients (Size, Markup)

Factors	Can1.	Can2.
Size of contract in SR	+0.084	-0.046
Type of contract	-0.015	+0.040
Duration	-0.029	-0.024
Location of project	+0.380	-0.092
Job start time	+0.410	+0.045
Portion subcontracted to others	+0.074	-0.069
Reliability of subcontractors	+0.239	-0.096
Availability of qualified staff	+0.136	-0.298
Availability of labor	+0.284	+0.048
Quality of available labor	-0.007	-0.012
Availability of equipment	+0.038	+0.034
Type of equipment required	-0.007	-0.044
Owner	-0.084	-0.135
Designer (A/E)	+0.076	+0.017
Design quality	+0.012	-0.081
Uncertainty in cost estimate	-0.147	+0.155
Past profit in similar jobs	+0.047	-0.113
General (office) overhead	-0.136	+0.084
Time of bidding (season)	+0.435	+0.058
Availability of required cash	-0.018	-0.091
Risk involved in investment	+0.241	-0.192
Competition	+0.229	-0.175
Strength in industry	+0.201	-0.042
Overall economy (availability of work)	-0.118	-0.001
Need for work	-0.321	+0.184
Current work load	+0.001	-0.096
Confidence in work force	+0.219	+0.001
Project cash flow	+0.000	+0.096
Time allowed for submitting bids	-0.033	-0.317
Establishing long relation with clients	+0.234	-0.214
Public exposure	+0.239	+0.025
Required bond capacity	+0.043	+0.084
Experience in such projects	-0.062	+0.246
Owner special requirements	-0.144	+0.072
Prequalification requirements	+0.271	+0.147
Bidding document price	+0.290	-0.023
Governmental division requirements	+0.152	+0.318

The variables causing the most discrimination are type of contract, reliability of subcontractors, availability of labor, type of equipment required, uncertainty in cost estimate, office overhead, time of bidding, strength in industry, overall economy, need for

work, confidence in work force, time allowed for submitting bids, required bond capacity, prequalification requirements, bidding document price, and government division requirements. Table 16 shows these variables.

Grouping the above variables, 83.3% of the bidding situation category factors are powerful discriminators. The economic situation category comes second with 50% of its factors as significant discriminators, then comes company characteristics with 43% of its factors contributing significantly to the discrimination.

In general, the main differences between the three classes are due to the company characteristics, bidding situation, and economic situation.

TABLE 16: Standardized Canonical Coefficients
(Size, Markup)

Factors	Can1.	Can2.
Size of contract in SR	+1.766	-0.765
Type of contract	-1.723	+2.401
Duration	-0.711	-0.132
Location of project	+1.691	+0.370
Job start time	+1.232	-1.910
Portion subcontracted to others	-0.817	+1.138
Reliability of subcontractors	+1.999	-2.565
Availability of qualified staff	-1.238	-1.317
Availability of labor	+0.720	+0.195
Quality of available labor	-1.161	+1.805
Availability of equipment	-3.188	+3.027
Type of equipment required	+3.854	-3.800
Owner	-1.401	-0.678
Designer (A/E)	-0.317	+1.729
Design quality	-0.138	-1.306
Uncertainty in cost estimate	-2.196	+2.032
Past profit in similar jobs	-1.524	+0.164
General (office) overhead	-3.102	+0.058
Time of bidding (season)	+3.440	+0.432
Availability of required cash	+1.067	-0.777
Risk involved in investment	+0.107	-0.389
Competition	+0.470	-0.883
Strength in industry	-3.190	+1.620
Overall economy (availability of work)	+2.530	-0.642
Need for work	-2.525	+0.533
Current work load	+1.665	+0.607
Confidence in work force	+3.319	-0.578
Project cash flow	+1.464	+1.888
Time allowed for submitting bids	+1.380	-2.220
Establishing long relation with clients	-1.176	+0.463
Public exposure	+0.038	-0.780
Required bond capacity	+2.587	+0.237
Experience in such projects	-0.935	-0.668
Owner special requirements	-0.129	-1.806
Prequalification requirements	-3.502	+2.928
Bidding document price	-4.044	+1.315
Governmental division requirements	+4.523	-0.685

As was done in chapter 4, contractors are classified into good and bad bidders. Tables 17 and 18 show the importance of the 37 factors. Generally, all of the factors are within the same importance range. Differences are not significant between good and bad

bidders. Figures 14 and 15 show the behavior of the broad categories as considered by good and bad bidders. No significant differences appear between both classes.

TABLE 17: Ranked Factors (Markup, Good)

Rank	Factor	Imp.
	A. PROJECT CHARACTERISTICS	73.83
2	Duration	82.14
3	Type of equipment required	82.14
6	Size of contract in SR	80.36
11	Location of project	77.55
18	Job start time	71.43
32	Owner	64.28
36	Project cash flow	58.93
	B. PROJECT DOCUMENTS	78.72
1	Type of contract	89.28
5	Design quality	80.95
12	Designer (A/E)	75.00
25	Owner special requirements	69.64
	C. COMPANY CHARACTERISTICS	72.59
4	Uncertainty in cost estimate	82.14
7	Establishing long relation with clients	80.36
8	Reliability of subcontractors	79.59
10	Need for work	78.57
14	Current work load	73.45
15	Availability of required cash	73.21
17	Past profit in similar jobs	71.43
20	General (office) overhead	71.43
22	Strength in industry	69.64
23	Confidence in work force	69.64
24	Experience in such projects	69.64
26	Public exposure	69.39
31	Portion subcontracted to others	65.31
33	Availability of qualified staff	62.50
	D. BIDDING SITUATION	69.30
13	Required bond capacity	73.45
16	Time allowed for submitting bids	73.21
19	Bidding document price	71.43
29	Time of bidding (season)	67.86
30	Prequalification requirements	67.35
34	Competition	62.50
	E. ECONOMIC SITUATION	66.70
9	Risk involved in investment	78.57
21	Availability of equipment	69.64
27	Governmental division requirements	68.57
28	Quality of available labor	67.86
35	Overall economy (availability of work)	62.50
37	Availability of labor	53.06

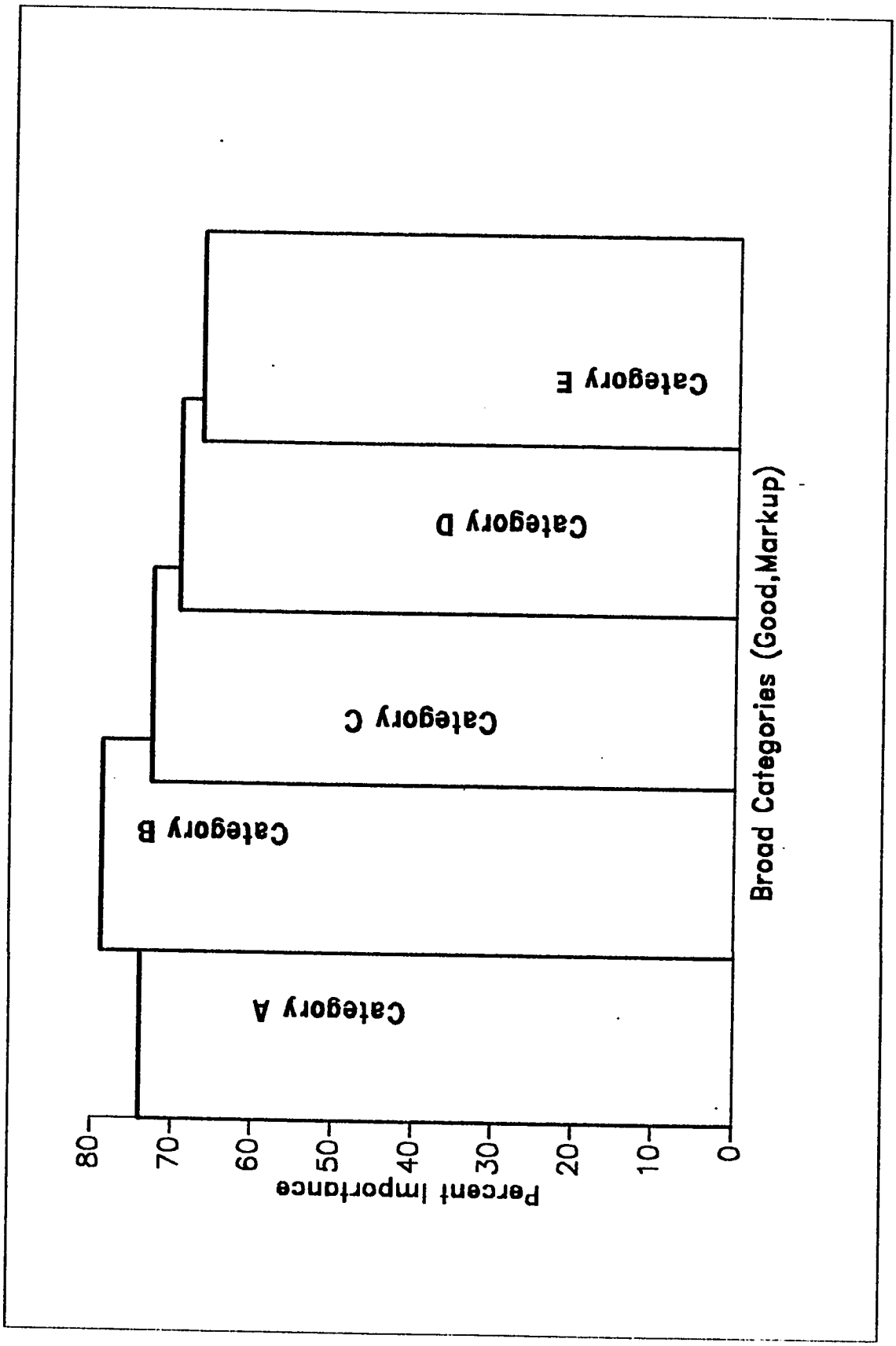

Figure 14: Broad Categories (Good, Markup)

TABLE 18: Ranked Factors (Markup, Bad)

Rank	Factor	Imp.
	A. PROJECT CHARACTERISTICS	75.22
1	Size of contract in SR	81.67
3	Project cash flow	79.63
5	Duration	77.66
13	Location of project	74.07
14	Type of equipment required	74.07
15	Owner	73.77
30	Job start time	65.66
	B. PROJECT DOCUMENTS	71.83
4	Type of contract	78.32
20	Owner special requirements	71.97
24	Design quality	71.16
28	Designer (A/E)	65.87
	C. COMPANY CHARACTERISTICS	71.53
2	Availability of required cash	81.48
7	Uncertainty in cost estimate	76.82
9	Confidence in work force	76.10
10	Strength in industry	75.47
11	Availability of qualified staff	75.26
16	Experience in such projects	73.54
18	Past profit in similar jobs	72.75
19	Need for work	72.22
21	Establishing long relation with clients	71.70
26	General (office) overhead	70.62
27	Current work load	69.31
31	Reliability of subcontractors	64.93
32	Portion subcontracted to others	63.01
35	Public exposure	58.24
	D. BIDDING SITUATION	63.40
17	Required bond capacity	72.80
22	Competition	71.69
33	Time allowed for submitting bids	61.64
34	Time of bidding (season)	60.85
36	Prequalification requirements	56.87
37	Bidding document price	56.58
	E. ECONOMIC SITUATION	72.57
6	Risk involved in investment	76.88
8	Availability of equipment	76.10
12	Overall economy (availability of work)	74.28
23	Quality of available labor	71.43
25	Availability of labor	70.92
29	Governmental division requirements	65.83

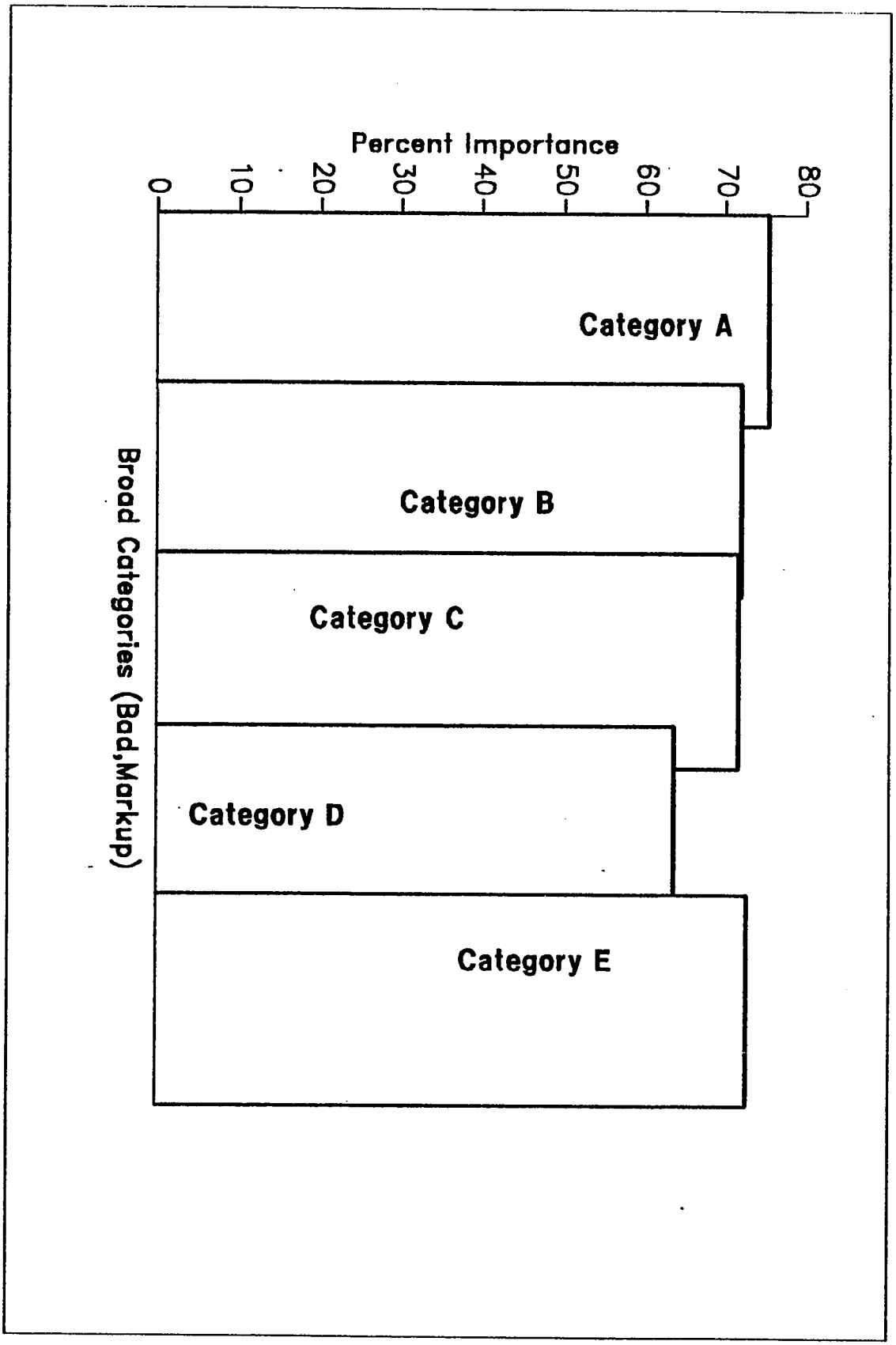

Figure 15: Broad Categories (Bad, Markup)

A Pearson correlation coefficient of 0.24 disagrees with the importance index. Trying to test the argument about the existence of the differences between good and bad bidders, discriminant analysis was used. The one and the only canonical function produced is significant and is powerful in discriminating between both classes. The canonical correlation coefficients suggest that both classes are different. A Wilks's lambda o 0.036 agrees with the canonical coefficients. The good bidders centroid is +16.00, while that of bad bidders is -1.60; thus they are different.

The canonical function is significantly related to only one variable is time allowed for submitting bids. Accordingly, it may be possible to assume that the underlying discrimination dimension is bidding situation. Table 19 shows the total Canonical coefficients.

Variables contributing significantly to discrimination are size of contract, type of contract, duration, location of project, job start time, portion subcontracted to others, reliability of subcontractors, availability of labor, quality of available labor, availability of required equipment, type of equipment required, owner, designer, design quality, uncertainty in cost estimate, past profit in similar jobs, office overhead, time of bidding, availability of required cash, competition, strength in industry, overall economy, confidence in work force, project cash flow, time allowed for submitting bids, public exposure, required bond capacity, experience in such projects, owner special requirements, prequalification requirements, bidding document price, and government division requirements. Table 20 shows the standardized canonical coefficients.

Grouping the above variables, project characteristics, project documents, and bidding situation are the strongest contributors. Then comes economic situation with 83.3% of its variables as significant, and finally company characteristics with 71% of its factors as significant discriminators.

Establishing long term relations with clients, availability of qualified staff, need for work, current work load, and risk involved in investment do not contribute much to the discrimination. This may be due to the nature of the variables. No matter what, the contractor can not ignore these variables. Good and bad bidders behave the same regarding these variables, which makes them weak discriminators.

In general, all of the five categories contribute significantly to the differences between both classes.

TABLE 19: Total Canonical Coefficients
(Good & Bad, Markup)

Factors	Can1.
Size of contract in SR	+0.281
Type of contract	+0.265
Duration	+0.153
Location of project	+0.121
Job start time	+0.106
Portion subcontracted to others	-0.270
Reliability of subcontractors	+0.120
Availability of qualified staff	+0.125
Availability of labor	+0.006
Quality of available labor	+0.124
Availability of equipment	+0.168
Type of equipment required	+0.205
Owner	+0.118
Designer (A/E)	+0.199
Design quality	+0.205
Uncertainty in cost estimate	+0.265
Past profit in similar jobs	+0.024
General (office) overhead	-0.031
Time of bidding (season)	+0.132
Availability of required cash	+0.169
Risk involved in investment	+0.194
Competition	+0.027
Strength in industry	+0.013
Overall economy (availability of work)	+0.045
Need for work	+0.078
Current work load	+0.086
Confidence in work force	+0.067
Project cash flow	-0.092
Time allowed for submitting bids	+0.308
Establishing long relation with clients	+0.037
Public exposure	+0.041
Required bond capacity	-0.012
Experience in such projects	+0.048
Owner special requirements	+0.039
Prequalification requirements	+0.173
Bidding document price	+0.202
Governmental division requirements	+0.144

TABLE 20: Standardized Canonical Coefficients
(Good & Bad, Markup)

Factors	Can1.
Size of contract in SR	+9.840
Type of contract	-11.569
Duration	+3.725
Location of project	-3.882
Job start time	+5.189
Portion subcontracted to others	-7.450
Reliability of subcontractors	+9.775
Availability of qualified staff	+0.774
Availability of labor	-5.356
Quality of available labor	-4.221
Availability of equipment	-5.180
Type of equipment required	+13.345
Owner	-2.067
Designer (A/E)	-5.604
Design quality	+7.385
Uncertainty in cost estimate	-6.979
Past profit in similar jobs	-6.649
General (office) overhead	-4.951
Time of bidding (season)	+11.090
Availability of required cash	-2.343
Risk involved in investment	-1.874
Competition	+3.407
Strength in industry	-7.195
Overall economy (availability of work)	+5.561
Need for work	-0.908
Current work load	-0.268
Confidence in work force	+5.398
Project cash flow	-5.779
Time allowed for submitting bids	+8.485
Establishing long relation with clients	-1.917
Public exposure	-3.343
Required bond capacity	+4.684
Experience in such projects	+5.769
Owner special requirements	+5.767
Prequalification requirements	-10.533
Bidding document price	-11.420
Governmental division requirements	+10.502

Chapter 6

SUMMARY & RECOMMENDATIONS

This chapter presents a summary of the study, the major findings, and recommendations.

6.1 Summary of the Study

Two difficult questions are always encountered by contractors; these are concerned with entering a bid and what markup to assign so as to be the lowest bidder and yet make a profit.

A review of the literature revealed that many quantitative models have been developed to help contractors overcome the problems they face when deciding on these two questions. Of these models, none seemed to be implemented in the construction industry.

This study tried to find another solution to the problem. If quantitative models are not good enough, why not try the qualitative approach? It is believed that if the factors that underlie both decisions are studied, then a better approach may be introduced to aid contractors in their hard task.

Three hundred questionnaires were sent to classified contractors all over the kingdom. Of these, only 71 were returned. The questionnaire used in this study was originally prepared for a study at the United States. In this study the questionnaire was modified to suit the construction environment in Saudi Arabia. The main part of the questionnaire was devoted to the factors that are believed to influence contractor's decision on the action to bid or not, and the size of markup to add.

Upon receiving back the questionnaires, the data was fed into the computer, which, through the use of SAS package, prepared the needed analysis.

6.2 Summary of Major Findings

1. Factors such as competition and profitability, which were considered by several researchers as the only important factors for modelling the bidding decision making process, are not the most important factors. Project cash flow and the availability of required cash are the two top factors in the decision to bid, while size of contract (in terms of price) and availability of required cash are the top two factors in the markup decision.
2. When deciding whether to bid or not, the behavior of contractors varies as to their size: small, medium and large. These differences are mainly due to company characteristics, the economic situation, and the bidding situation.

3. When deciding whether to bid or not, the behavior of good bidders is different from that of bad bidders. The differences are basically due to the consideration of some variables. These are the portion subcontracted to others, the reliability of subcontractors, the design quality, and public exposure.

4. When deciding on markup size, the behavior of contractors varies according to their size. The main cause of the change is due to the difference in considering company characteristics, the bidding situation, and the economic situation.

5. When deciding on markup size, the behavior of good and bad bidders is different. Project characteristics, project documents, company characteristics, the bidding situation, and the economic situation contribute significantly to the differences.

6. Calculating the average importance index for good bidders when they decide to bid (79.6) and when they decide on the markup size (72.0), the decision to bid or not is more important than the decision on the markup size. This is logical since the second decision depends on the first. If the contractor decides not to bid, then the second decision becomes meaningless. The same behavior is repeated by the bad bidders. When deciding to bid, their index is 77.2, while when deciding on markup, the index is 71.1. Accordingly, the decision to bid or not is the most critical decision a contractor will make.

7. The importance of the 37 factors does not change significantly with the change in contractor's class. This may be due to the weakness of the importance index as a tool to show the real differences that are easily discovered by discriminant analysis.

8. Large contractors are the closest in their attitude to good contractors attitude when they consider the rank of broad categories. This is strange since most of the large contractors that contributed in this study did not satisfy the good bidders classification. However, this may be due to the classification itself; it is possible that the standards set by this study to distinguish good bidders from bad bidders are high if compared with today's tough bidding environment. Another possibility is that large contractors are reporting attitudes and not behavior. They think (attitude) that certain factors have certain importance but they may not reflect this attitude when it comes to behavior.

9. Considering any factor with an importance index of 80 or more as most important, type of contract, design quality, reliability of subcontractors, availability of required cash, governmental division requirements, availability of qualified staff, risk involved in investment, establishing long term relations with clients, size of contract, need for work, required bond capacity, location of project, designer (A/E), uncertainty in cost estimate, project cash flow, experience in such projects, bidding document price, quality of available labor, confidence in work force, owner, and strength in

industry are considered the most important factors for good bidders' decision to bid or not.

10. Type of contract, duration of project, type of equipment required, uncertainty in cost estimate, design quality, size of contract, and establishing long term relations with clients are considered the most important factors for the good bidders' decision on the proper size of markup.

11. Considering any factor with an importance index of 60 or less as least important, the portion subcontracted to others is the least important factor for good bidders' decision to bid. This finding may seem to contradict the previous finding that portion subcontracted to others contributes significantly to the discrimination between good and bad bidders. However, being a powerful discriminator does not mean that it is important to good bidders.

12. Project cash flow, and availability of labor are the least important factors for good bidders' decision on the size of markup.

Other findings related to contractors' characteristics:

A detailed discussion of the contractors' characteristics is included in Appendix II.

1. The majority of contractors obtain a good amount of their work through competitive bidding.
2. Eighty-one percent of the firms use some statistical techniques. This behavior was not expected; however, this result may be due to the generality of the question. This question did not specify what is meant by statistical techniques.
3. Good bidders constitute only 18.8% (13 firms), while the majority are bad bidders. The majority of good bidders are small firms.
4. The majority of the firms are either building or engineering contractors.
5. The majority of building or engineering firms do building or engineering projects most of the time.
6. The majority of the firms are either grade 1 or grade 2, 30% are either grade 3 or grade 4, and only 7% are grade 5.
7. The majority of the firms are small, then comes medium, and then large.
8. Most contractors operate either in the Western or Central provinces, then comes the Northern, then the Eastern, then the Southern, and finally international. The findings can be generalized to the whole Kingdom.

9. The majority of contractors operating today are very strong. They passed the recession and still survive in today's tough environment.

10. Most contractors operating today were mainly of the building or engineering type, but due to the recession in building and engineering projects, they became involved in other types of activities such as trading. This was noticed when sending questionnaires to listed construction contractors and finding out that they no longer do construction, but instead had changed to trading or other activities.

11. It is possible to conclude that most of the large contractors did not sustain the sudden drop in the market. This may be due to their large overhead. Small contractors continued to operate.

6.3 Recommendations

1. In order for contractors to enhance their chances of taking the right decision of bidding or not, they are advised to emphasize the following factors:

Type of contract, design quality, reliability of subcontractors, availability of required cash, governmental division requirements, availability of qualified staff, risk involved in investment, establishing long term relations with clients, size

of contract, need for work, required bond capacity, location of project, designer (A/E), uncertainty in cost estimate, project cash flow, experience in such projects, bidding document price, quality of available labor, confidence in work force, owner, strength in industry, and public exposure.

Special attention should be directed to reliability of subcontractors, design quality, and public exposure. The portion subcontracted to others should not be emphasized.

2. In order for contractors to enhance their chances of assigning the right markup size to the right job, they are advised to emphasize on the following factors:

Type of contract, duration of project, type of equipment required, uncertainty in cost estimate, design quality, size of contract, and establishing long term relations with clients. Project cash flow, and availability of labor should not be emphasized.

3. The decision to enter a bid is the most critical decision for any contractor. Accordingly, contractors are recommended to study this decision thoroughly before committing themselves.

6.3.1 Recommendations for Future Studies

Future studies could pursue the following:

1. Study each factor alone and develop a procedure by which contractors can make sure that they are taking care of each factor according to its importance.
2. Develop an expert system that will help contractors decide whether to bid or not, and how much markup to add.

APPENDICES

APPENDIX (I)

BIDDING QUESTIONNAIRE

(ENGLISH and ARABIC)

BIDDING QUESTIONNAIRE

This questionnaire is a part of a study that will try to find out the factors that affect the contractor's bidding decisions . If you are interested you may provide us with a P.O. Box so as to send you the results of the study . You can be sure that your identity will not be known to us since you are not required to write your address .

All responses will remain fully confidential . Please respond by putting a check mark next to the appropriate number .

Title of the respondent_____

FIRST, QUESTIONS ABOUT YOUR FIRM

(a) Type & Grade of contractor *(check all that apply)

	% Of Work	Grade
(1) Building (Educational, Comm.)	____	____
(2) Engineering (Highway, Heavy)	____	____
(3) Industrial (Power Plants, Refin.)	____	____
(4) Others (Please specify)_____	____	____
TOTAL	=100%	

(b) Annual Business Volume
* (Millions of Saudi Riyals)_____

(c) Number of Permanent Employees
*(include trade & foremen)_____

(d) Number of Temporary Employees (Mainly Labors)_____

(e) Value of Construction Equipment Owned (Millions of SR)

(1) Under 1 ___ (2) 2-10 ___ (3) 11-25 ___

(4) 26-100 ___ (5) Over 100 ___

(f) % of Equipment Leased or Rented

(1) None ___ (2) Less than 25% ___ (3) 26%-50% ___

(4) 51%-75% ___ (5) 76%-100% ___

(g) Amount of work (in SR) Subcontracted on Average Job

(1) None ___ (2) Less than 25% ___ (3) 26%-50% ___

(4) 51%-75% ___ (5) 76%-100% ___

(h) Average Contract Size (Millions of SR)

(1) Less than 5 ___ (2) 6-10 ___ (3) 11-25 ___

(4) 26-50 ___ (5) 51-100 ___ (6) 101-200 ___

(7) 201-300 ___ (8) More than 300 ___

(i) Average Contract Duration (years)_____

(j) Region of Operation (check all that apply)

(1) East ___ (2) West ___ (3) North ___

(4) South ___ (5) Center ___ (6) International ___

(7) Other (please specify) _____

(k) Number of Area/Branch Offices (not site offices)
*Excluding Main Office _____

(l) Number Of Years In Business _____

SECOND, QUESTIONS ABOUT THE FACTORS THAT INFLUENCE YOUR BID DECISIONS

(m) Please Indicate How Important Is Each Of The Following Factors To (I) Your Decision To Bid Or Not , And (II) The Percent Markup You Will Seek , If You Do Bid.

*** High Importance= H ; Low Importance = L ***

*** Markup= Bid Price - Estimated Project Cost ***

*** Please Answer By Circling The Appropriate Number ***

		(I) BID/NO BID	(II) % MARKUP
		H-----|-----L	H-----|-----L
(1)	Size Of Contract In (SR)	7 6 5 4 3 2 1	7 6 5 4 3 2 1
(2)	Type Of Contract	7 6 5 4 3 2 1	7 6 5 4 3 2 1
(3)	Duration	7 6 5 4 3 2 1	7 6 5 4 3 2 1
(4)	Location Of Project	7 6 5 4 3 2 1	7 6 5 4 3 2 1
(5)	Job Start Time	7 6 5 4 3 2 1	7 6 5 4 3 2 1
(6)	Portion Subcontracted To Others	7 6 5 4 3 2 1	7 6 5 4 3 2 1
(7)	Reliability Of Subs	7 6 5 4 3 2 1	7 6 5 4 3 2 1
(8)	Availability Of Qualified Staff	7 6 5 4 3 2 1	7 6 5 4 3 2 1
(9)	Availability Of Labors	7 6 5 4 3 2 1	7 6 5 4 3 2 1
(10)	Quality Of Available Labors	7 6 5 4 3 2 1	7 6 5 4 3 2 1
(11)	Availability Of Equipment	7 6 5 4 3 2 1	7 6 5 4 3 2 1

	(I) BID/NO BID H-----|-----L	(II) % MARKUP H-----|-----L
(12) Type Of Equipment Req.	7 6 5 4 3 2 1	7 6 5 4 3 2 1
(13) Owner	7 6 5 4 3 2 1	7 6 5 4 3 2 1
(14) Designer (A/E)	7 6 5 4 3 2 1	7 6 5 4 3 2 1
(15) Design Quality	7 6 5 4 3 2 1	7 6 5 4 3 2 1
(16) Uncertainty In Cost Estimate	7 6 5 4 3 2 1	7 6 5 4 3 2 1
(17) Past Profit In Similar Jobs	7 6 5 4 3 2 1	7 6 5 4 3 2 1
(18) General (Office) Overhead	7 6 5 4 3 2 1	7 6 5 4 3 2 1
(19) Time Of Bidding (season)	7 6 5 4 3 2 1	7 6 5 4 3 2 1
(20) Availability Of Required Cash	7 6 5 4 3 2 1	7 6 5 4 3 2 1
(21) Risk Involved In Investment	7 6 5 4 3 2 1	7 6 5 4 3 2 1
(22) Competition	7 6 5 4 3 2 1	7 6 5 4 3 2 1
(23) Your Strength In Industry	7 6 5 4 3 2 1	7 6 5 4 3 2 1
(24) Overall Economy (Availability Of Work)	7 6 5 4 3 2 1	7 6 5 4 3 2 1
(25) Need For Work	7 6 5 4 3 2 1	7 6 5 4 3 2 1
(26) Current Work Load	7 6 5 4 3 2 1	7 6 5 4 3 2 1
(27) Confidence In Your Work Force	7 6 5 4 3 2 1	7 6 5 4 3 2 1
(28) Project Cash Flow	7 6 5 4 3 2 1	7 6 5 4 3 2 1
(29) Time Allowed For Submitting Bids	7 6 5 4 3 2 1	7 6 5 4 3 2 1
(30) Establishing Long Term Relationships With Clients	7 6 5 4 3 2 1	7 6 5 4 3 2 1
(31) Public Exposure	7 6 5 4 3 2 1	7 6 5 4 3 2 1
(32) Required Bond Capacity	7 6 5 4 3 2 1	7 6 5 4 3 2 1
(33) Your Experience In Such Projects	7 6 5 4 3 2 1	7 6 5 4 3 2 1
(34) Owner Special Requirements	7 6 5 4 3 2 1	7 6 5 4 3 2 1
(35) Prequalification Requirements	7 6 5 4 3 2 1	7 6 5 4 3 2 1
(36) Bidding Document Price	7 6 5 4 3 2 1	7 6 5 4 3 2 1
(37) Government Division Requirements	7 6 5 4 3 2 1	7 6 5 4 3 2 1
Others: (Please Specify)		
(38) _____	7 6 5 4 3 2 1	7 6 5 4 3 2 1
(39) _____	7 6 5 4 3 2 1	7 6 5 4 3 2 1
(40) _____	7 6 5 4 3 2 1	7 6 5 4 3 2 1

THIRD, QUESTIONS THAT REFER TO THE FIRM'S PRACTICE REGARDING BIDDING DECISION MAKING PROCESS

(n) Percentage Of Work Obtained Through Competitive Bidding

(1) Under 25% ___ (2) 26%-50% ___

(3) 51%-75% ___ (4) 76%-100% ___

(o) Office Overhead Expenses Are

(1) Included In Markup ___

(2) Charged As A Cost Item ___

(3) Either Of The Above Depending On The Job ___
(4) Others (Please Specify) _____

(p) Job Related Contingency Is

(1) Included In Markup ___

(2) Charged As A Cost Item ___

(3) Either Of The Above Depending On The Job ___
(4) Others (Please Specify) _____

(q) Uncertainty In The Cost Item Is

(1) Considered By Applying A Correction Factor ___

(2) Considered By Adjusting Markup ___

(3) Not Considered ___

(4) Others (Please Specify) _____

(r) What Time In The Year Is Best For Bidding?

(1) Beginning Of The Fiscal Year ___

(2) End Of The Fiscal Year ___

(3) Does Not Depend On The Fiscal Year ___

(4) Other (Please Specify) _____

(s) What Job Size You Think Are Best For Your Firm?
* (In Millions Of SR)_____

(t) What Job Durations You Think Are Best?
* (Years)_____

(u) Do You Use Any Statistical/Mathematical Techniques To Assess Your Competitive Situation?

(1) Yes ___

(2) No ___

(v) In The Last 10 Jobs You Bid :

(1) How Many Times Did You Win ____

(2) How Many Times You Were The Lowest Bidder ____

(3) How Many Times You Finished Within Required Time ____

(4) How Many Times You Finished Within Estimated Cost ____

(5) How Many Times You Wished You Did Not Bid ____

(w) If You Have Any Additional Comments That Would Help Us Understand Your Firm's Bidding, Please Feel Free TO Add Them Below.

_____

_____

_____

_____

THANK YOU VERY MUCH FOR YOUR COOPERATION.

استبيان بخصوص عروض المناقصات

هذا الاستبيان جزء من دراسة نحاول ايجاد العوامل التى تؤثر على قرارات المقاول بخصوص المناقصات . اذا كنت ترغب فى الحصول على نتائج هذا الاستبيان فما عليك الا ان تزودنا بعنوانك . وللمعلومية فان كل الردود ستبقى سرية للغاية وسوف تستعمل لغرض الابحاث فقط.

الرجاء الاجابه على الاسئلة التاليـــه :

* منصـــب المجيب : _____

اولا : اسئلة بخصوص المؤســـــــــــة

(أ) نوع المقاول ودرجته (يمكنك اختيار اكثر من اجابة)

	نسبة العمل	درجة المقاول
(١) مبانى (تعليمية ،تجاريه ،سكنيه .. الخ)	_____	_____
(٢) هندسى (طرق ،انشاءات ثقيله .... الخ)	_____	_____
(٣) صناعى (محطات كهرباء ، مصافى.... الخ)	_____	_____
(٤) غير ذلك (الرجاء تحديـــــد) _____	_____	_____
	١٠٠ ٪	

(ب) ماحجم عملك السنوى ؟

* ملايين الريالات السعوديـــه : _____

(ج) ماعدد الموظفين الدائمين (بما فيهم المهنيين والمراقبين) _____

(د) ماعدد الموظفين المؤقتين (اجمالا العمال) _____

(هـ) ثمن معدات الانشاء المملوكه للشركه (ملايين الريالات) :

١- أقل من ١ _____ ٢- ٢ - ١٠ _____ ٣- ١١ - ٢٥ _____

٤- ٢٦ - ١٠٠ _____ ٥- اكثر من ١٠٠ _____

(و) نسبة المعدات التى تستأجرونها فى المشاريع المتوسطه

١- لاشى _____ ٢- اقل من ٢٥ ٪ _____ ٣- ٠٫٠٢٦ - ٠٫٠٥٠ _____

٤- ٠٫٠٥١ - ٠٫٠٧٥ _____ ٥- ٠٫٠٧٦ - ٠٫٠١٠٠ _____

(ز) كمية العمل (بالريالات) التى تعطونها لمقاولين بالباطن فى المشاريع المتوسطه :

١- لاشـــى _____ ٢- اقل من ٢٥ ٪ _____ ٣- ٠٫٠٢٦ - ٠٫٠٥٠ _____

٤- ٠٫٠٥١ - ٠٫٠٧٥ _____ ٥- ٠٫٠٧٦ - ٠٫٠١٠٠ _____

(ح) متوسط قيمة العقود التى تقومون بتنفيذها (ملايين الريالات) .

١- اقل من ٥ ـــــــ ٢- ٦ - ١٠ ـــــــ ٣- ١١ - ٢٥ ـــــــ
٤- ٢٦ - ٥٠ ـــــــ ٥- ٥١ - ١٠٠ ـــــــ ٦- ١٠١ - ٢٠٠ ـــــــ
٧- ٢٠١ - ٣٠٠ ـــــــ ٨- اكثر من ٣٠٠ ـــــــ

(ط) متوسط مدة العقود التى تقومون بتنفيذها (بالسنوات) : ـــــــــــ

(ى) منطقة العمل فى السعوديه وخارجها (اختر كل ماينطبق)

١- الشرق ـــــــ ٢- الغرب ـــــــ ٣- الشمال ـــــــ
٤- الجنوب ـــــــ ٥- الوسط ـــــــ ٦- عالميا ـــــــ
٧- اماكن اخرى (الرجاء تحديد) ـــــــــــــــــــــــــــــــ

(ك) عدد المكاتب الفرعيه (باستثناء المكتب الرئيسى ،ومكاتب الموقع) ـــــــــــ

(ل) عدد سنوات العمل فى هذا المجال : ـــــــــــ

ثانيا : (أسئله بخصوص العوامل التى تؤثر فى قرارتكم بخصوص عروض المناقصات)
====

(م) الرجاء تحديد درجة اهمية كل من العوامل التاليه على :-

١- قرارك للدخول فى المناقصه ام لا .
٢- نسبة الربح التى ستطلبها اذا دخلت المناقصه

*** الربح = قيمة العطاء ـــ القيمه المقدره للمشروع ***
*** ش = شديد الاهميه ، ق = قليل الاهميـــــــة ***

*** ملاحظـــــه :- (١)دخول المناقصه / ام لا (٢) نسبة الربـح
ش ـــــــــ ق ش ـــــــــ ق
أجب بوضع دائره حول الرقم المناسب

(١) قيمة العقد (بالريالات)	١ ٢ ٣ ٤ ٥ ٦ ٧	١ ٢ ٣ ٤ ٥ ٦ ٧
(٢) نوع العقـــــد	١ ٢ ٣ ٤ ٥ ٦ ٧	١ ٢ ٣ ٤ ٥ ٦ ٧
(٣) مدة العقـــــد	١ ٢ ٣ ٤ ٥ ٦ ٧	١ ٢ ٣ ٤ ٥ ٦ ٧
(٤) موقع المشروع	١ ٢ ٣ ٤ ٥ ٦ ٧	١ ٢ ٣ ٤ ٥ ٦ ٧
(٥) وقت بدء العمل	١ ٢ ٣ ٤ ٥ ٦ ٧	١ ٢ ٣ ٤ ٥ ٦ ٧
(٦) الكميه المعطاه للمقاول بالباطن	١ ٢ ٣ ٤ ٥ ٦ ٧	١ ٢ ٣ ٤ ٥ ٦ ٧
(٧) كفاءة المقاولين بالباطـــــن	١ ٢ ٣ ٤ ٥ ٦ ٧	١ ٢ ٣ ٤ ٥ ٦ ٧

(١) دخول المناقصه/املا (٢) نسبة الربح

	ش ——— ق	ش ——— ق
(٨) توفر الطاقم الكفء	١ ٢ ٣ ٤ ٥ ٦ ٧	١ ٢ ٣ ٤ ٥ ٦ ٧
(٩) توفر العمـــــال	١ ٢ ٣ ٤ ٥ ٦ ٧	١ ٢ ٣ ٤ ٥ ٦ ٧
(١٠) نوعيه (كفاءة) العمال المتوفرين	١ ٢ ٣ ٤ ٥ ٦ ٧	١ ٢ ٣ ٤ ٥ ٦ ٧
(١١) توفر المعـــدات	١ ٢ ٣ ٤ ٥ ٦ ٧	١ ٢ ٣ ٤ ٥ ٦ ٧
(١٢) نوعية المعدات المطلوبه	١ ٢ ٣ ٤ ٥ ٦ ٧	١ ٢ ٣ ٤ ٥ ٦ ٧
(١٣) مصمم المشـــــــروع	١ ٢ ٣ ٤ ٥ ٦ ٧	١ ٢ ٣ ٤ ٥ ٦ ٧
(١٤) المالك	١ ٢ ٣ ٤ ٥ ٦ ٧	١ ٢ ٣ ٤ ٥ ٦ ٧
(١٥) جودة التصميم	١ ٢ ٣ ٤ ٥ ٦ ٧	١ ٢ ٣ ٤ ٥ ٦ ٧
(١٦) نسة الخطأ فى تقدير الاسعار	١ ٢ ٣ ٤ ٥ ٦ ٧	١ ٢ ٣ ٤ ٥ ٦ ٧
(١٧) الربح من مشاريع مشابهه نفذتموها فى الماضـــى	١ ٢ ٣ ٤ ٥ ٦ ٧	١ ٢ ٣ ٤ ٥ ٦ ٧
(١٨) التكاليف الاداريه العامه	١ ٢ ٣ ٤ ٥ ٦ ٧	١ ٢ ٣ ٤ ٥ ٦ ٧
(١٩) وقت الدخول فى المناقصات (الموسم)	١ ٢ ٣ ٤ ٥ ٦ ٧	١ ٢ ٣ ٤ ٥ ٦ ٧
(٢٠) توفر المال المطلوب للعمل	١ ٢ ٣ ٤ ٥ ٦ ٧	١ ٢ ٣ ٤ ٥ ٦ ٧
(٢١) درجة المخاطره فى الارتباط بالمناقصه	١ ٢ ٣ ٤ ٥ ٦ ٧	١ ٢ ٣ ٤ ٥ ٦ ٧
(٢٢) المنافسه	١ ٢ ٣ ٤ ٥ ٦ ٧	١ ٢ ٣ ٤ ٥ ٦ ٧
(٢٣) قوتك ومكانتك فى السوق	١ ٢ ٣ ٤ ٥ ٦ ٧	١ ٢ ٣ ٤ ٥ ٦ ٧
(٢٤) الوضع-الاقتصادى فى البلد (توفر العمل)	١ ٢ ٣ ٤ ٥ ٦ ٧	١ ٢ ٣ ٤ ٥ ٦ ٧
(٢٥) الحاجه للعمل	١ ٢ ٣ ٤ ٥ ٦ ٧	١ ٢ ٣ ٤ ٥ ٦ ٧
(٢٦) عـــبء العمل الحالـــى	١ ٢ ٣ ٤ ٥ ٦ ٧	١ ٢ ٣ ٤ ٥ ٦ ٧
(٢٧) ثقتك فى موظفيك وعمالك	١ ٢ ٣ ٤ ٥ ٦ ٧	١ ٢ ٣ ٤ ٥ ٦ ٧
(٢٨) السيوله الماليه للمشروع	١ ٢ ٣ ٤ ٥ ٦ ٧	١ ٢ ٣ ٤ ٥ ٦ ٧
(٢٩) الوقت الممنوح لتسليم العطاءات	١ ٢ ٣ ٤ ٥ ٦ ٧	١ ٢ ٣ ٤ ٥ ٦ ٧
(٣٠) تاسيس علاقات طويلة المدى مع زبائنك	١ ٢ ٣ ٤ ٥ ٦ ٧	١ ٢ ٣ ٤ ٥ ٦ ٧
(٣١) الدعايه الخارجيه	١ ٢ ٣ ٤ ٥ ٦ ٧	١ ٢ ٣ ٤ ٥ ٦ ٧
(٣٢) حجم الضمـانات البنكيه المطلوبه	١ ٢ ٣ ٤ ٥ ٦ ٧	١ ٢ ٣ ٤ ٥ ٦ ٧
(٣٣) خبرتك فى مشاريع مشابهه	١ ٢ ٣ ٤ ٥ ٦ ٧	١ ٢ ٣ ٤ ٥ ٦ ٧
(٣٤) بعض متطلبات المالك الخاصه	١ ٢ ٣ ٤ ٥ ٦ ٧	١ ٢ ٣ ٤ ٥ ٦ ٧
(٣٥) سعر وثائق العطاء	١ ٢ ٣ ٤ ٥ ٦ ٧	١ ٢ ٣ ٤ ٥ ٦ ٧
(٣٦) متطلبات التأهل	١ ٢ ٣ ٤ ٥ ٦ ٧	١ ٢ ٣ ٤ ٥ ٦ ٧
(٣٧) متطلبـات الدوائر الحكوميه	١ ٢ ٣ ٤ ٥ ٦ ٧	١ ٢ ٣ ٤ ٥ ٦ ٧
* غير ذلك (الرجاء تحديد)		
(٣٨) _____	١ ٢ ٣ ٤ ٥ ٦ ٧	١ ٢ ٣ ٤ ٥ ٦ ٧
(٣٩) _____	١ ٢ ٣ ٤ ٥ ٦ ٧	١ ٢ ٣ ٤ ٥ ٦ ٧
(٤٠) _____	١ ٢ ٣ ٤ ٥ ٦ ٧	١ ٢ ٣ ٤ ٥ ٦ ٧

ثالثا : أسئله بخصوص نهج المقاول فى اتخاذ القرارات المتعلقه بدخول المناقصات واعداد العطاءات

(ن) نسبة العمل الناتجه من المناقسه العامه :

(١) اقل من ٢٥ ٠/٠ ـــــــ ٢ـ ٠/٠٢٦ ـ ٥٠ ٠/٠ ـــــــ

(٣) ٠/٠٥١ ـ ٧٥ ٠/٠ ـــــــ ٤ـ ٠/٠٧٦ ـ ٠/٠١٠٠ ـــــــ

(س) تكاليف الاداره العامه

(١) محسوبه ضمن الربح ـــــــ

*** الربح = قيمة العطاء ـ قيمة المشروع المقدره ***

(٢) محسوبه كاحد بنود التسعير ـــــــ

(٣) اى من (١) او (٢) حسب نوع العمل ـــــــ

(٤) غير ذلك (الرجاء تحديد) ـــــــــــــــــــــــــــــــ

(ع) الاحتماء ضد الاخطاء المتوقع حدوثها فى المشروع :

(١) محسوبه ضمن الربح ـــــــ

(٢) محسوبه كاحد بنود التسعير ـــــــ

(٣) اىمن (١) او (٢) حسب نوع العمل ـــــــ

(٤) غير ذلك (الرجاءالتحديد) ـــــــــــــــــــــــــــــــ

(ف) احتمالات الخطأ فى تقدير الاسعار :ـ

(١) تعتبر باستخدام معامل للتعديل ـــــــ

(٢) تعتبر بتعديل الربح ـــــــ

(٣) لاتعتبر ـــــــ

(٤) غير ذلك (الرجاءالتحديد) ـــــــ ـــــــــــــــــــــــــــــــ

(ص) اى وقت فى السنه انسب لدخول المناقصات :

(١) بداية السنه الماليه ـــــــ

(٢) نهاية السنه الماليه ـــــــ

(٣) لايعتمد على السنه الماليه ـــــــ

(٤) غير ذلك (الرجاء التحديد) ـــــــــــــــــــــــــــــــ

(ق) ماهو انسب حجم عمل لمؤسستك (ملايين الريالات) ـــــــــــــــــــ

(ر) ماانسب مدة مشاريع بالنسبه لمؤسستك ـــــــــــــــــــ

(ش) هل تستعمل اى طرق حسابيه او احصائيه لتحديد ربحك :-

(١) نعم : _____
(٢) لا : _____

(ت) فى العشرة مشاريع الاخيره التى نافستم فى مناقصاتها :-

(١) كم مره كنت الفائز بالمشروع : _____
(٢) كَم مره كنت صاحب اقل عطاء _____
(٣) كم مره انهيت المشروع فى المده المحدده _____
(٤) كم مره انهيت المشروع ضمن السعر المقدر _____
(٥) كم مره تمنيت انك لم تدخل المناقصه _____

(ث) اذا كانت لديك اى اقتراحات اضافيه خاصه بطرق التعامل مع المناقصات فالرجاء كتابتها فى الفراغ التالى :-

_____

_____

_____

_____

شكرا جزيلا لتعاونكم. ،،،

بسم الله الرحمن الرحيم

Ministry of Higher Education
King Fahd University of Petroleum & Minerals

وزارة التعليم العالي
جامعة الملك فهد للبترول والمعادن

February 20, 1990.

Dear Manager,

The Construction Engineering & Management of the College of Environmental Design at King Fahd University of Petroleum & Minerals is presently engaged in a study of the factors that affect bidding and markup decisions in Saudi Arabia.

The purpose of this study is to try to find out a better way by which contractors can calculate their markup, and use more rational way of determining whether to bid or not.

We are asking you to participate by providing needed information related to your assessment on the factors that your firm is using and the degree of importance to your firm. We promise that all data of individual firms will be held in strict confidence and will be used for research purposes only. We know that there are numerous demands on your time. However, your involvement is important in contributing to the study. The questionnaire will take about 20 minutes of your valuable time.

The attached questionnaire consists of three sections. The first section seeks information about your firm. The second section seeks information related to the importance of the factors for bidding and markup decisions. The third section seeks your evaluation related to your firm's current practice regarding the bidding decision markup process.

We shall, therefore, highly appreciate your kindness towards us in rendering the information as per our needs. Your contribution in this regard is highly appreciated.

Enclosed with this letter are two questionnaires; one in Arabic and the other in English. It is to your convenience to complete either form.

Your immediate action will be highly appreciated. Please return the completed questionnaire in the self addressed envelope as soon as possible.

Thank you for your cooperation.

Sincerely yours,

Dr. Ali A. Shash
Director Study

Nader Abdul-Hadi

Nader H. Abdul-Hadi
Research Associate

الظهران ٣١٢٦١ المملكة العربية السعودية ● تلفون ٨٦٠٠٠٠٠ (٠٣) ● تلكس : ٨١٩٥٠ جافهد ● برقيا : الجامعة
DHAHRAN 31261, SAUDI ARABIA Telephone : (03) 860-0000 Telex : 801060 KFUPM SJ Cable. : AL-JAMAAH

بسم الله الرحمن الرحيم

وزارة التعليم العالي
جامعة الملك فهد للبترول والمعادن
الظهران ٣١٢٦١ المملكة العربية السعودية

Ministry of Higher Education
King Fahd University of Petroleum & Minerals
DHAHRAN 31261, SAUDI ARABIA

التاريخ : ١٩٩٠/٢/٢٠ م

السيد المدير — الموقـــــــر

تحيه طيبه وبعد ،،،

يقوم قسم هندسة وادارة التشييد فى كلية تصاميم البيئه بجامعة الملك فهد للبترول والمعادن بعمل دراسة عن العوامل التى تؤثر فى قرارات المناقصات ،ونسبة الربح فى العطاءات التى يقدمها المقاولون فى المملكه العربيه السعوديه .

الغرض من الدراسه هو محاولة ايجاد وسائل مطوره يستطيع المقاول بواسطتها حساب نسبة الربح فى اى مشروع ، ويستطيع اتخاذ القرار بدخول المناقصه ام لا .

مساهمتك فى هذه الدراسه تكون بتزويدنا بالمعلومات الضروريه لمعرفة العوامل التى تؤثر على قراراتكم بخصوص المناقصات ومدى أهمية هذه العوامل . كل المعلومات ستعامل بسريه تامه ونعدكم بانها لن يستخدم الا لغرض البحث فقط . مع علمنا انكم فى أمس الحاجه لكل دقيقه من وقتكم الثمين ولكن مشاركتكم ضرورية جدا لانجاح الدراسه. الاستبيان المرفق لن يأخذ من وقتكم الثمين اكثر من ٢٠ دقيقه .

الاستبيان المرفق يتكون من ثلاثة أقسام . القسم الاول فيه أسئلة عن مؤسستكم .والقسم الثانى فيه أسئلة عن أهمية العوامل المؤثره فى نسبة الربح وقرارات الدخول فى المناقصات . اما القسم الثالث ففيه بعض الاسئلة التى ستساعدنا على فهم المنهج الذى تتبعونه فى الدخول الى منافسه العقود وتقديم العطاءات .

تكرمكم بتزويدنا بالمعلومات اللازمه لاتمام الدراسه سيكون موضع تقديرنا واحترامنا . ومرفق مع هذه الرساله استبيانين احدهما باللغه العربيه والاخر بالانجليزية بامكانكم الاجابه عن اى منهما كما ترونه مناسبا . تجاوبكم السريع سوف يساهم فى اتمام الدراسه والانتفاع بنتائجها فى المستقبل القريب . فالرجاء موافاتنا بالاستبيان المكمل فى أسرع وقت ممكن ، فى الظرف المغنون المرفق .

وتقبلوا فائق الاحترام . ،،،

د. علـــى ع شـــــاش
أستاذ مساعد ،مشرف على الدراسة

نادر ح . عبد الهـــــادى
مشـــارك فى البحـــث

Telephone : 860-0000
Telex : 801060 KFUPM SJ
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تلفـــون : ٨٦٠ - ٠٠٠٠ (٠٣)
تلكـــس : ٨٠١٩٥٠ جافهد
برقيـــا : الجامعة

بسم الله الرحمن الرحيم

وزارة التعليم العالي
جامعة الملك فهد للبترول والمعادن
الظهران ٣١٢٦١ المملكة العربية السعودية

Ministry of Higher Education
King Fahd University of Petroleum & Minerals
DHAHRAN 31261, SAUDI ARABIA

التاريخ ١٤١٠/٩/٨ هـ

السيد المدير ـــــــ الموقر ـــــــ

تحيه طيبه وبعد ،،،

نود ان نهنئكم بحلول شهر رمضان المبارك راجين من الله ان يعيده علينا جميعا بالخير واليمن والبركه . لقد سبق ان ارسلنا لسعادتكم استبيانا بخصوص العوامل التى تؤثر فى قرارات المقاولين بالنسبه لدخول المناقصات ونسبة الربح التى يطلبونها ولم يصلنا منكم اى رد حتى تاريخه .

ونود ان نلفت عنايتكم الى ان الاستبيان جزء من دراسة يعتمد اتمامها ونجاحها على مشاركتكم الفعاله بامدادنا بالمعلومات المطلوبه .

نتائج هذه الدراسه سوف تعود على صناعة التشييد فى المملكه بالنفع الكبير . ولذا نرجو من سعادتكم التعاون معنا وارسال الاستبيان مكملا فى أسرع وقت ممكن . ولكم الشكر الجزيل .

ونؤكد لكم مرة اخرى ان المعلومات لن تستخدم الا لاغراض البحث فقط ، وانها لن تعرض بصوره فرديه ولن يعرف مصدر المعلومات مطلقا .

*** ملاحظه : اذا كنتم قد ارسلتم الاستبيان فلكم الشكر الجزيل ونعدكم ان جهدكم لن يضيع سدى .

د. على ع. شاش
استاذ مساعد/مشرف على الدراسه

Telephone : 860-0000
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Cable. : AL-JAMAAH

تلفون : ٨٦٠ - ٠٠٠٠ (٠٣)
تلكس : ٨٠١٩٥٠ جافهد
برقيا : الجامعة

APPENDIX (II)

CONTRACTORS' CHARACTERISTICS

Characteristics of Participating Contractors

The contractors' characteristics are described below on the basis of their type, grade, size, region of operation, and operating experience.

I. Types of Contractors

Basically, there are four types of contractors. Building, engineering, industrial, and others. In the local environment most of the contractors are specialized in more than one type. This fact introduced other types of contractors such as, building & engineering, or industrial and others. Table 1 shows the different types and the number of contractors undertaking each type.

TABLE 1: Types Of Contractors

Contractor Type	Number	Percent
Build	10	14.1
Eng	14	19.7
Ind	2	2.8
Build & Eng	10	14.1
Build & Eng & Ind	8	11.2
Build & Eng & Others	4	5.6
Build & Eng & Ind & Others	9	12.7
Build & Ind	3	4.2
Build & Ind & Others	3	4.2
Build & Others	2	2.8
Eng & Ind	1	1.4
Eng & Others	3	4.2
Ind & Others	2	2.8

From table 1 it can be seen that 11 of the 13 contractor types are involved in either building, engineering, or both. This suggests that the main type of contractor in the Saudi environment is either

building or engineering. The results indicated that about 47.9% of the contractors are either building or engineering type, 46.5% of the contractors do building or engineering works besides industrial or others, and only 5.6% of the contractors do not undertake building or engineering type projects.

Table 1 shows that 67 of the 71 contractors are involved in building or engineering projects either 100% or less.

Therefore, almost all contractors perform more than one type of work. This means that different types of work are performed with different percentages. Table 2 shows contractor types and their work percentages.

TABLE 2: Average Percentages Of Work

Contractor Type	Average percentage Of Work			
	Build	Eng	Ind	Others
Build	100			
Eng		100		
Ind			100	
Build & Eng	53.12	46.8		
Build & Eng & Ind	68.5	19.2	12.3	
Build & Eng & Ind & Others	16.2	41.6	15.9	27.5
Build & Eng & Others	27.5	53.8		18.8
Build & Ind	46.6		53.3	
Build & Ind & Others	60		13.3	26.6
Build & Others	75			25
Eng & Ind		80	20	
Eng & Others		68.3		31.6
Ind & Others			74.5	25.5

Almost all firms that undertake building or engineering types of projects besides other types concentrate on building or engineering types of work. For example, if building and engineering and industrial contractors are considered, 87.7% of their work is building or engineering type, while only 12.3% is industrial.

One conclusion to be drawn is that the majority of contractors operating in the Saudi construction environment are of either building or engineering type, with the majority of their work as building or engineering projects. The remaining types are not as involved in their specialization as building or engineering contractors.

Another conclusion is that most of the contractors were mainly of the building or engineering type, but due to the recession in the construction industry they became involved in other types of activities such as trading.

Regardless of the contractor's type, the majority of the contractors subcontract less than 25% of the work to others. Table 3 shows the distribution of the percentage of work subcontracted by contractors to others.

TABLE 3: Distribution of % of Work Subcontracted

SUB	Freq	Percent	Cum Freq	Cum %
Non	11	15.5	11	15.5
<25%	48	67.6	59	83.1
26%-50%	11	15.5	70	98.6
76%-100%	1	1.4	71	100.0

Another finding of the study is that about 54% of the firms obtain 51% or more of their work through competitive bidding, 26% of the firms obtain 25%-50%, and only 20% obtain less than 25% of their work through competitive bidding. Thus, in general it can be said that most of the contractors obtain good amount of their work through competitive bidding.

If the duration of projects is considered, it is found that 46% of the firms do projects that last for about two years, 23% do projects that last for about one year, and 15% do projects that last for around three years. Thus, 84% of the contractors undertake projects that last between 1-3 years.

II. Contractor's Grade

The firms contributing to this study are classified contractors, thus each one has a class or grade. According to the Chamber of Commerce there are five classes (grades), where grade 1 is the highest and grade 5 is the lowest.

When considering contractor's grades, a different approach is used. This approach considers the building type as any contractor is involved in buildings even if only partially. This assumption holds true for all other types; thus the summation of the contractors does not equal to "71" because there is an overlap between different types of contractors. For example, engineering substitutes for engineering, engineering and industrial, engineering and others, etc. Table 4 shows the distribution of the grades.

TABLE 4: Distribution Of Grades

Type	Grade1	Grade2	Grade3	Grade4	Grade5
Build	14(30.4%)	17(36.9%)	6(13.0%)	5(10.9%)	4(8.7%)
Eng	18(43.9%)	8(19.5%)	7(17.1%)	6(14.6%)	2(4.9%)
Ind	6(24%)	8(32%)	3(12%)	6(24%)	2(8%)
Others	3(16.7%)	8(44.4%)	3(16.7%)	3(16.7%)	1(5.6%)
TOTAL	41	41	19	20	9

From table 4 it is noted that the building type contractors are mainly with grade 1 or grade 2 (30.4% + 36.9% =67.3%), and the engineering firms show the same behavior (43.9% + 19.5% =63.4%), Also, the industrial and the other behave the same. From this analysis it is obvious that all types are mainly of grade 1 or grade 2, then comes grade 3 and grade 4, and finally grade 5.

Another way of looking at table 4 would show that engineering firms contribute the most to grade 1 (18/41=43%), then comes building firms (14/41=34%), then industrial (6/41=14.6%), and finally others (7.3%). The same analysis is done for grade 2, grade 3, grade 4, and grade 5. The result is that building and engineering contributes the most in all grades.

In general, it can be concluded that most of the contractors are mainly grade 1 or grade 2, then comes grade 3 and 4, and then grade 5.

III. Contractor's Size

The contractor's size can be indicated by many measures such as annual business volume, the number of permanent employees, the number of temporary employees, the value of equipment owned, and the percentage of equipment leased or rented on average jobs.

A. Business Volume

The business volume of the firms ranges from a minimum of SR 1.0 million to a maximum of SR 250.0 million. The increase is gradual; there is no sudden jump in volume. Another point is that 65% or more of the firms have a business volume less than SR 50.0 million, 22% have business volume between SR 50.0 million and SR 140.0 million, and only 13% have more than SR 140.0 million. Thus, the sample can be divided into three groups according to their business volume. These are as follows:

1. Business Volume < SR 50 million (Small)
2. Business Volume > SR 140 million (Large)
3. SR 50 million < Business Volume < SR 140 million (Medium)

Figure 1 shows this classification.

B. Permanent Employees

This subvariable ranges from a minimum of 4 employees to a maximum of 2500. As in business volume, there is no big gap. sixty-nine percent of the firms have their permanent employees less than or equal to 200, 24% of them have their employees between 200 and 1000, and only 7% have more than 1000 employees. Thus, the

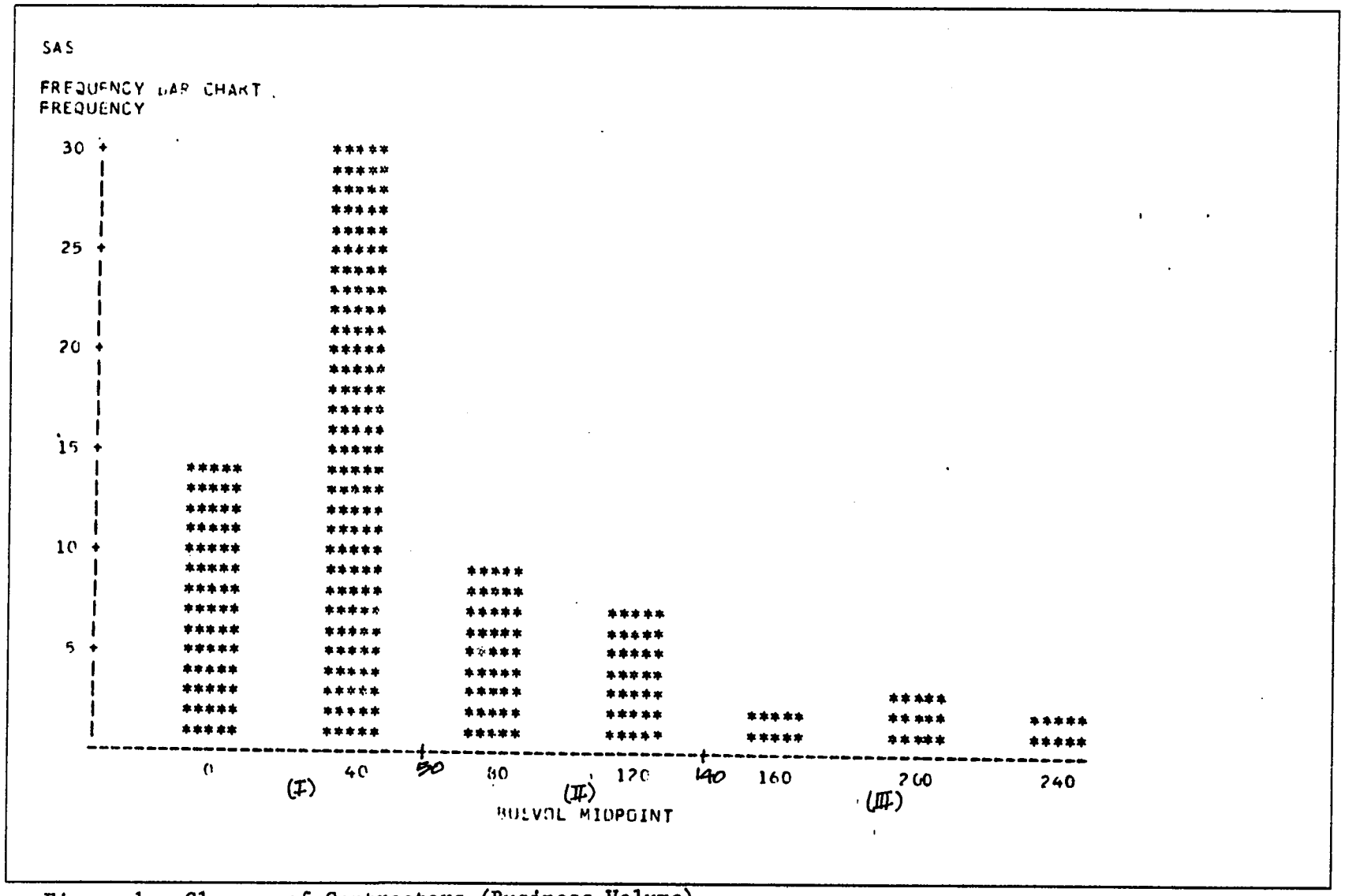

Figure 1: Classes of Contractors (Business Volume)

majority of firms have their permanent employees less than or equal to 200 employees as shown in the histogram of figure 2.

C. Temporary Employees

This measure is found to range from a minimum of zero to a maximum of 3500 employees. The largest category lies between zero and 250 employees. This category contains 84% of the employees. The next category, which is 250-1000 employees contains 10% of the firms. The last category, which is for contractors having temporary employees greater than 1000, contains only 6% of the firms, as shown in figure 3.

From the distribution of the permanent and temporary employees, it can be said that the majority of the firms fall within the first category, which can be described as small firms. On the average, about 76% of the firms satisfy this category. The next category contributes on the average to about 17% of the firms (medium firms), while the last contributes on the average to about 6.5% only (large firms).

D. Value Of Equipment Owned

The value of equipment owned by the firm could be used as a measure for the contractor's size. Table 5 shows the distribution of the value of equipment owned. It is assumed that as the value of equipment owned increases, the size of the contractor increases.

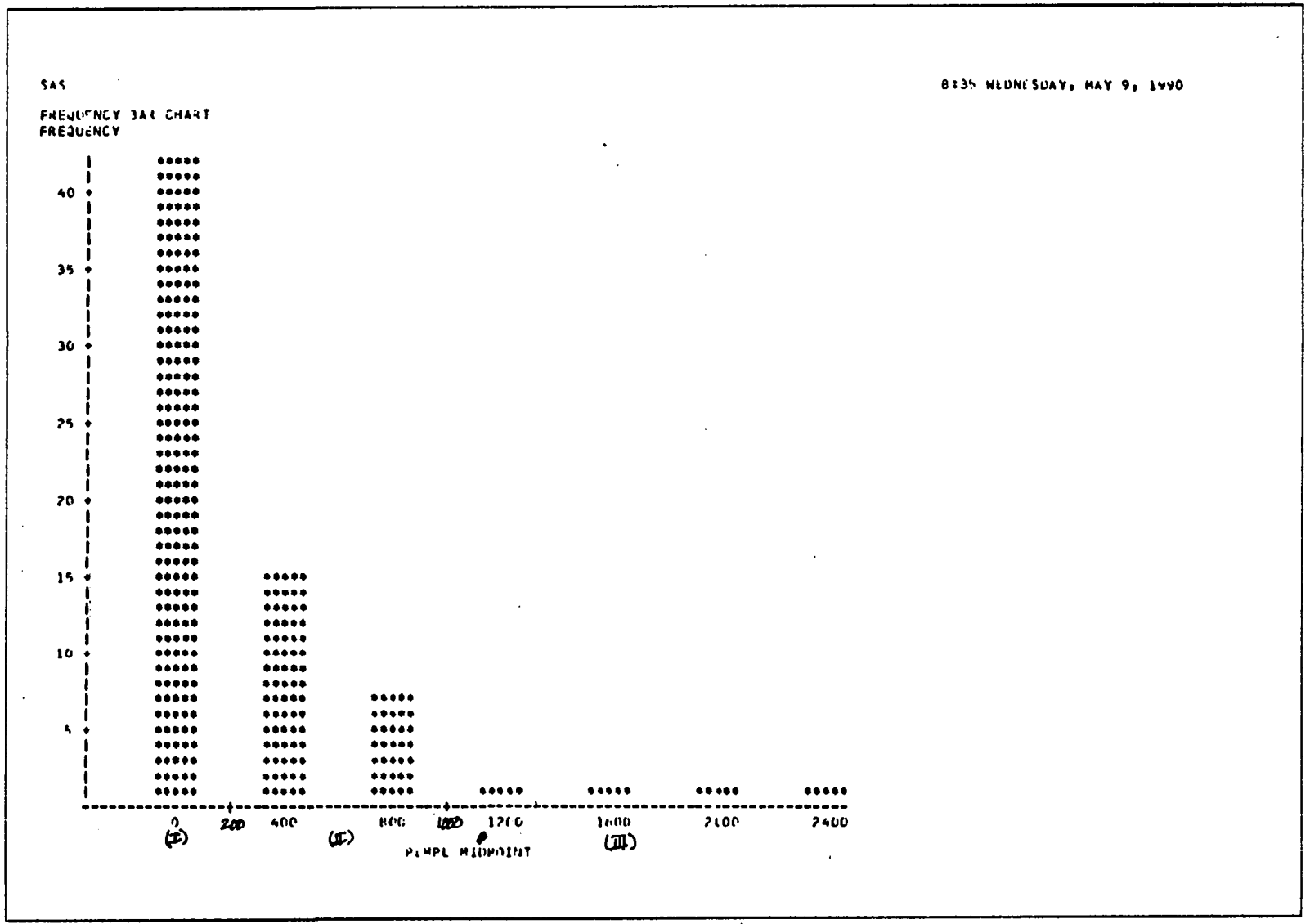

Figure 2: Classes of Contractors (Permanent Employees)

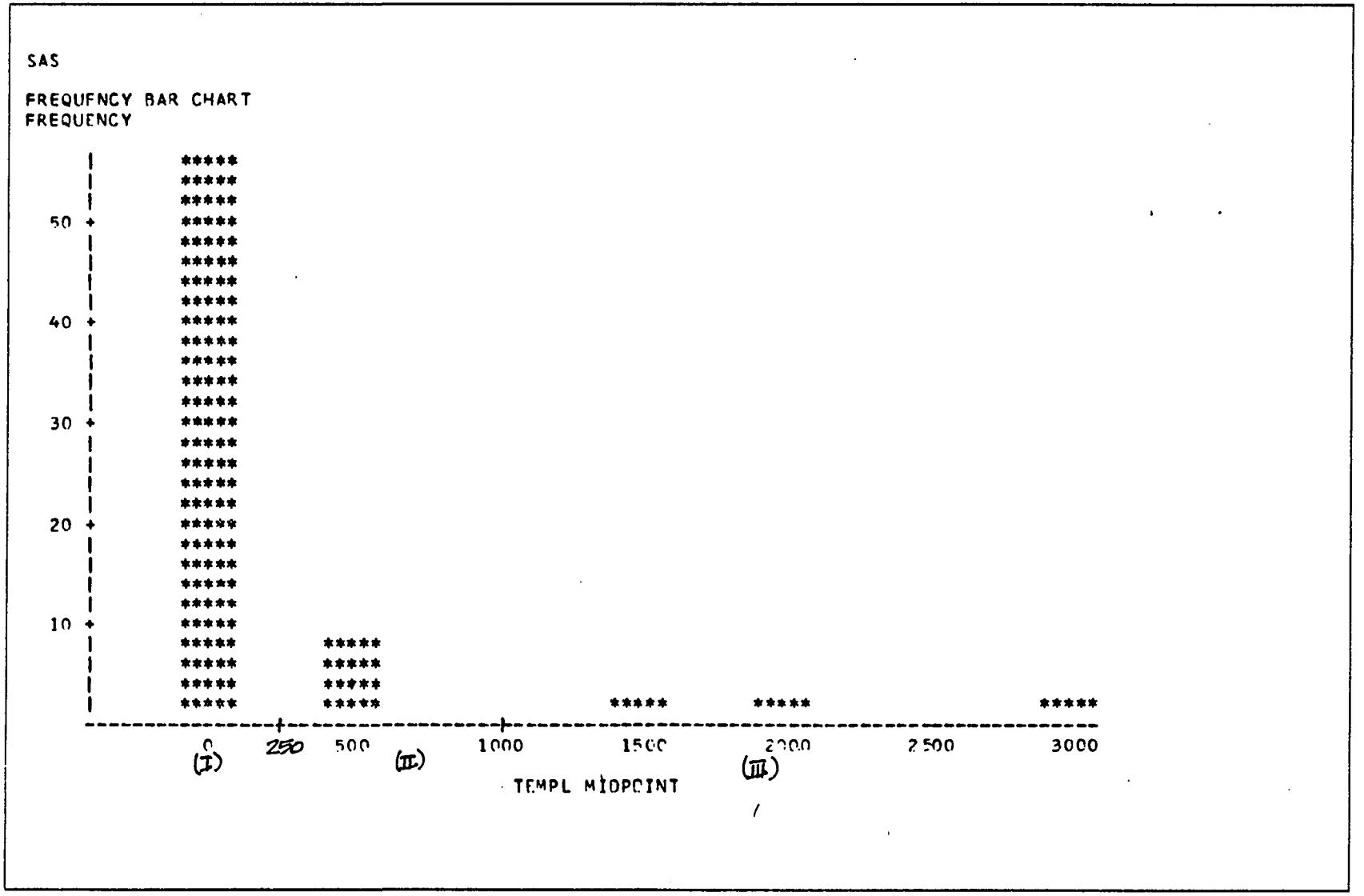

Figure 3: Classes of Contractors (Temporary Employees)

TABLE 5: Distribution of Value of Equipment Owned

VEQ	Frequency	Percent	Cum Freq	Cum %
<1 mill	14	19.7	14	19.7
2-10 mill	26	36.6	40	56.3
11-25 mill	10	14.1	50	70.4
26-100 mill	17	23.9	67	94.4
>100 mill	4	5.5	71	100

The highest percentage (36.6%) of the contractors have equipment valued between SR 2-10 millions, then the next highest (23.9%) have equipment worth between SR 26-100 million. Table 5 gives the impression that the majority of contractors are middle class.

E. Percentage Of Equipment Leased Or Rented

The percentage of equipment leased or rented by the firm on average jobs was also used to describe the size of the firm. As this percentage increases, it is assumed that the size of the firm will decrease. Table 6 shows the distribution of the percentage of equipment leased or rented by the contractors on average jobs.

TABLE 6: Percentage of Equipment Leased or Rented

PEQ	Freq	Percent	Cum Freq	Cum %
Non	13	18.3	13	18.3
<25%	52	73.2	65	91.5
26%-50%	5	7.0	70	98.6
51%-75%	1	1.4	71	100

The majority of contractors (73.2%) lease or rent less than 25% of the equipment in order to work on average jobs. This suggests that the majority of the firms are large.

It is noticed that the classification of the firms changes as different measures are considered. For example, when dealing with business volume, temporary employees, and permanent employees, the majority of the contractors are small, then medium, then large. This behavior changes if the percentage of equipment leased or rented are considered. This could be the result of the change in contractor's type. Some firms depend heavily on equipment to accomplish their work. These contractors usually have a high value of equipment owned even if they are not really large. Some other firms may have the opposite situation.

In general, engineering firms depend heavily on equipment, while building firms are less dependent. Building firms depend mainly on labor.

It is also noticed that the number of employees and the value of equipment may introduce misleading results because as the type of contractor changes, the variables that best reflect his size change. A good measure for the building contractor size is the number of employees, while for an engineering type it is the value of equipment owned.

In a conclusion, neither value of equipment nor number of employees may reflect the correct size of different types of firms. A better measure is business volume. Business volume is independent from the contractor type.

In this study business volume is used to classify contractors into different sizes.

IV. Region Of Operation

The region of operation is an important characteristic of the firm, since it helps in generalizing the findings of the study . For example if the operations cover all the regions of Saudi Arabia, then it may be concluded that the findings can be generalized; otherwise it would not be precise to assume the generalization.

Reviewing the results of the descriptive statistics, it is evident that most of the contractors operate either in the Western or Central province, then comes the Northern, then the Eastern, then the Southern province, and finally international. Thus, the findings can be generalized to the whole kingdom, but not anywhere else. Table 7 shows the percentages for each region. It should be remembered that the percentages will not add up to 100% since different contractors operate in more than one region.

TABLE 7: Percentages Of Operation In Regions

Region Of Operation	Percent
Western Province	62.9
Central Province	62.9
Northern Province	52.9
Eastern Province	47.1
Southern Province	34.3
International	5.7

Usually the number of area offices is related to the regions of operation. If the contractor operates in three regions he will have three offices. In the questionnaire the contractor was asked to exclude site offices and the main office; thus a contractor answering "two offices" means that he actually operates in three regions. The distribution of the number of offices is as shown in table 8.

TABLE 8: Number Of Area Offices

Number Of Offices	Percent	Number Of Regions
0	21.5	1
1	21.5	2
2	30.8	3
3	23.1	4
4	1.5	5
7	1.5	6

It is not always true that the number of regions is greater than the number of offices by one. This is because some contractors may have more than one office in one region.

V. Years In Business

A very important variable is the years in business. Contractors may be classified as those having experience greater than 7 years, and those with less than or equal to 7 years. It is believed that the behavior of the two groups will be different because those having experience greater than 7 years worked during the boom and continued while the others started just after the boom during the recession.

The majority of the contractors operating today experienced the boom only 21.4% began during the recession period. This supports the idea that the demand on construction decreased sharply after the drop in oil prices. It also suggests that the majority of contractors operating today are very strong that they passed the sudden drop in the economic situation and they are still operating.

APPENDIX (III)

DISCRIMINANT ANALYSIS

* Contractors' Sizes (Bid) *

SAS 12:36 TUESDAY, MAY 15, 1990

CANONICAL DISCRIMINANT ANALYSIS

55 OBSERVATIONS 54 DF TOTAL
37 VARIABLES 52 DF WITHIN CLASSES
3 CLASSES 2 DF BETWEEN CLASSES

	CANONICAL CORRELATION	ADJUSTED CANONICAL CORRELATION	APPROX STANDARD ERROR	SQUARED CANONICAL CORRELATION	EIGENVALUES OF INV(E)*H = CANRSQ/(1-CANRSQ) EIGENVALUE	DIFFERENCE	PROPORTION	CUMULATIVE
1	0.905128	0.829456	0.024596	0.819256	4.5327	1.3439	0.5870	0.5870
2	0.872507	0.797787	0.032487	0.761268	3.1888	.	0.4130	1.0000

TESTS OF H0: THE CANONICAL CORRELATION IN THE CURRENT ROW AND ALL THAT FOLLOW ARE ZERO

	LIKELIHOOD RATIO	F	NUM DF	DEN DF	PR > F
1	0.04314924	1.6493	74	32	0.0588
2	0.23873174	1.5058	36	17	0.1846

MULTIVARIATE TEST STATISTICS AND F APPROXIMATIONS
S=2 M=17 N=7

STATISTIC	VALUE	F	NUM DF	DEN DF	PR > F
WILKS' LAMBDA	0.04314924	1.649	74	32	0.0588
PILLAI'S TRACE	1.580525	1.731	74	34	0.0394
HOTELLING-LAWLEY TRACE	7.721501	1.565	74	30	0.0863
ROY'S GREATEST ROOT	4.532699	2.083	37	17	0.0535

NOTE: F STATISTIC FOR ROY'S GREATEST ROOT IS AN UPPER BOUND
F STATISTIC FOR WILKS' LAMBDA IS EXACT

SAS

CANONICAL DISCRIMINANT ANALYSIS

RAW CANONICAL COEFFICIENTS

	CAN1	CAN2
M1	0.101927756	-0.926095652
M2	-1.686891726	0.407160598
M3	1.614855002	-0.260057608
M4	-0.202879380	0.403494821
M5	-0.977478981	-0.150090307
M6	0.548093723	-0.177355144
M7	-0.161352534	0.341552302
M8	1.908003206	1.242260440
M9	-0.623074807	0.311553795
M10	-0.738141838	-1.982005632
M11	0.860311415	1.170937161
M12	0.721764318	-1.535009024
M13	-0.009136077	0.452948404
M14	0.246503327	-0.098890314
M15	0.373400797	-0.395291161
M16	-0.788268104	0.143156840
M17	-0.859368763	0.102241642
M18	0.096104226	-0.612533052
M19	-0.671735659	0.935762955
M20	1.126727919	0.309553139
M21	0.102992481	-0.621406235
M22	0.164603128	-0.337485232
M23	-0.912778845	0.362111420
M24	-0.695457968	-0.941243873
M25	-0.611807773	-1.081738352
M26	0.086490345	0.759572129
M27	-0.321905879	0.794390325
M28	-0.180565501	0.021772168
M29	0.836885460	-0.652534389
M30	2.282421739	0.446637732
M31	0.185061033	0.452592486
M32	-0.382496018	0.329989127
M33	-1.181343850	0.217333203
M34	0.371938104	-1.607749010
M35	-0.970293965	0.691880695
M36	-0.646051833	0.062836716
M37	0.264781319	0.232112954

CLASS MEANS ON CANONICAL VARIABLES

SIZE	CAN1	CAN2
LARGE	4.1847	-4.2224
MEDIU	-2.6447	-1.1299
SMALL	0.8338	1.2953

CANONICAL DISCRIMINANT ANALYSIS

55	OBSERVATIONS	54 DF TOTAL
37	VARIABLES	53 DF WITHIN CLASSES
2	CLASSES	1 DF BETWEEN CLASSES

	CANONICAL CORRELATION	ADJUSTED CANONICAL CORRELATION	APPROX STANDARD ERROR	SQUARED CANONICAL CORRELATION	EIGENVALUES OF INV(E)*H = CANRSQ/(1-CANRSQ) EIGENVALUE	DIFFERENCE	PROPORTION	CUMULATIVE
1	0.909060	0.846862	0.023625	0.826390	4.7600	.	1.0000	1.0000

TESTS OF H0: THE CANONICAL CORRELATION IN THE CURRENT ROW AND ALL THAT FOLLOW ARE ZERO

	LIKELIHOOD RATIO	F	NUM DF	DEN DF	PR > F
1	0.17360975	2.1870	37	17	0.0431

MULTIVARIATE TEST STATISTICS AND EXACT F STATISTICS
S=1 M=17.5 N=7.5

STATISTIC	VALUE	F	NUM DF	DEN DF	PR > F
WILKS' LAMBDA	0.1736098	2.187	37	17	0.0431
PILLAI'S TRACE	0.8263902	2.187	37	17	0.0431
HOTELLING-LAWLEY TRACE	4.760045	2.187	37	17	0.0431
ROY'S GREATEST ROOT	4.760045	2.187	37	17	0.0431

Good

SAS

CANONICAL DISCRIMINANT ANALYSIS

RAW CANONICAL COEFFICIENTS

	CAN1
M1	1.232708811
M2	-0.235699507
M3	0.238298249
M4	0.675818834
M5	-0.057236561
M6	-1.227236583
M7	1.132402685
M8	-1.148505596
M9	0.569389422
M10	0.208182219
M11	0.111086560
M12	0.929712553
M13	0.141452122
M14	-0.471300058
M15	1.285327958
M16	0.687345417
M17	-0.344342747
M18	-0.149452826
M19	-0.707386457
M20	-0.840859393
M21	0.386862295
M22	-0.313135850
M23	-0.505531795
M24	0.110820910
M25	0.164759087
M26	-0.567072947
M27	0.317566800
M28	-0.131255980
M29	-0.013369110
M30	1.028512863
M31	-1.321069446
M32	-0.229110646
M33	-0.412411904
M34	-0.200372645
M35	0.528003719
M36	0.392494226
M37	0.028053273

CLASS MEANS ON CANONICAL VARIABLES

BID	CAN1
BAD	-0.6773
GOOD	6.7727

CANONICAL DISCRIMINANT ANALYSIS

44	OBSERVATIONS	43	DF TOTAL
37	VARIABLES	41	DF WITHIN CLASSES
3	CLASSES	2	DF BETWEEN CLASSES

	CANONICAL CORRELATION	ADJUSTED CANONICAL CORRELATION	APPROX STANDARD ERROR	SQUARED CANONICAL CORRELATION	EIGENVALUE	DIFFERENCE	PROPORTION	CUMULATIVE
					EIGENVALUES OF INV(E)*H = CANRSQ/(1-CANRSQ)			
1	0.948123	0.900599	0.015412	0.898938	8.8949	4.1935	0.6542	0.6542
2	0.908076	0.836356	0.026748	0.824603	4.7013	.	0.3458	1.0000

TESTS OF H0: THE CANONICAL CORRELATION IN THE CURRENT ROW AND ALL THAT FOLLOW ARE ZERO

	LIKELIHOOD RATIO	F	NUM DF	DEN DF	PR > F
1	0.01772606	0.8799	74	10	0.6525
2	0.17539710	0.7836	36	6	0.7073

MULTIVARIATE TEST STATISTICS AND F APPROXIMATIONS
S=2 M=17 N=1.5

STATISTIC	VALUE	F	NUM DF	DEN DF	PR > F
WILKS' LAMBDA	0.01772606	0.880	74	10	0.6525
PILLAI'S TRACE	1.72354	1.011	74	12	0.5326
HOTELLING-LAWLEY TRACE	13.59622	0.735	74	8	0.7720
ROY'S GREATEST ROOT	8.894873	1.442	37	6	0.3436

NOTE: F STATISTIC FOR ROY'S GREATEST ROOT IS AN UPPER BOUND
F STATISTIC FOR WILKS' LAMBDA IS EXACT

SAS

CANONICAL DISCRIMINANT ANALYSIS

RAW CANONICAL COEFFICIENTS

	CAN1	CAN2
N1	1.673104331	-0.724674939
N2	-1.667705720	2.324296459
N3	-0.666334714	-0.123335893
N4	1.104592816	0.241868543
N5	0.704547704	-1.091964624
N6	-0.496975129	0.692187577
N7	1.301350217	-1.669402959
N8	-1.163818682	-1.238302450
N9	0.621350624	0.168304398
N10	-1.145218845	1.780566703
N11	-2.417598897	2.294950418
N12	3.135198550	-3.091417058
N13	-1.120804709	-0.542331600
N14	-0.167589058	0.914568549
N15	-0.103742857	-0.978633616
N16	-1.706814955	1.579715234
N17	-1.223858073	0.131807200
N18	-2.154112463	0.040045009
N19	1.654466408	0.207791903
N20	0.935855835	-0.681339442
N21	0.096980414	-0.351573842
N22	0.433306184	-0.813473618
N23	-2.875703573	1.460401963
N24	2.547267825	-0.646557655
N25	-2.661092313	0.561576017
N26	1.211501484	0.441534648
N27	3.322538985	-0.578613109
N28	1.299978023	1.676318677
N29	0.785769924	-1.263773828
N30	-1.173958742	0.462130209
N31	0.022976069	-0.476660592
N32	2.069780918	0.189662555
N33	-1.019637742	-0.728621755
N34	-0.096407890	-1.343983127
N35	-1.946522596	1.627816329
N36	-2.248055926	0.731080475
N37	3.140513735	-0.475410497

CLASS MEANS ON CANONICAL VARIABLES

SIZE	CAN1	CAN2
LARGE	-4.8172	-4.6803
MEDIU	-2.6542	2.3799
SMALL	2.4498	-0.3967

* Good and Bad (Markup) *

SAS

14:14 THURSDAY, MAY 17, 1990

CANONICAL DISCRIMINANT ANALYSIS

44	OBSERVATIONS	43	DF TOTAL
37	VARIABLES	42	DF WITHIN CLASSES
2	CLASSES	1	DF BETWEEN CLASSES

	CANONICAL CORRELATION	ADJUSTED CANONICAL CORRELATION	APPROX STANDARD ERROR	SQUARED CANONICAL CORRELATION	EIGENVALUES OF INV(E)*H = CANRSQ/(1-CANRSQ) EIGENVALUE	DIFFERENCE	PROPORTION	CUMULATIVE
1	0.981873	0.966968	0.005478	0.964075	26.8361	.	1.0000	1.0000

TESTS OF H0: THE CANONICAL CORRELATION IN THE CURRENT ROW AND ALL THAT FOLLOW ARE ZERO

	LIKELIHOOD RATIO	F	NUM DF	DEN DF	PR > F
1	0.03592459	4.3518	37	6	0.0357

MULTIVARIATE TEST STATISTICS AND EXACT F STATISTICS
S=1 M=17.5 N=2

STATISTIC	VALUE	F	NUM DF	DEN DF	PR > F
WILKS' LAMBDA	0.03592459	4.352	37	6	0.0357
PILLAI'S TRACE	0.9640754	4.352	37	6	0.0357
HOTELLING-LAWLEY TRACE	26.83609	4.352	37	6	0.0357
ROY'S GREATEST ROOT	26.83609	4.352	37	6	0.0357

Good.

SAS

CANONICAL DISCRIMINANT ANALYSIS

RAW CANONICAL COEFFICIENTS

	CAN1
N1	9.32493005
N2	-11.19931154
N3	3.48940057
N4	-2.53587635
N5	2.96684875
N6	-4.53220211
N7	6.36124255
N8	0.72749803
N9	-4.62238785
N10	-4.16408701
N11	-3.92775088
N12	10.85593062
N13	-1.65360684
N14	-2.96457614
N15	5.53173180
N16	-5.42534932
N17	-5.34098362
N18	-3.43790784
N19	5.33394046
N20	-2.05503864
N21	-1.69358415
N22	3.13952965
N23	-6.48683402
N24	5.59768635
N25	-0.95684793
N26	-0.19523811
N27	5.40355664
N28	-5.13134145
N29	4.83137044
N30	-1.91308187
N31	-2.04277235
N32	3.74788871
N33	6.28890529
N34	4.29217010
N35	-5.85499648
N36	-6.34755257
N37	7.29271080

CLASS MEANS ON CANONICAL VARIABLES

BID	CAN1
BAD	-1.6005
GOOD	16.0051

APPENDIX (IV)

COMPARISON BETWEEN

K.S.A. and U.S.A. BIDDERS

The "t" test is used to try to decide whether to accept or reject the null hypothesis. The following formula is used to calculate the t.

$$t_{n-2} = \frac{r\sqrt{n-2}}{\sqrt{1-r^2}}$$

Where:

n= number of observations= 24

r= correlation coefficients= 0.397

$t_{22} = 2.0288$

$t_{0.025} = 2.074$

At a confidence level of 95%, the calculated t (2.0288) is less than the critical value (2.074), then the correlation coefficient of 0.397 is not significant and thus U.S.A. and K.S.A. bidders are different (failure to reject the null hypothesis).

TABLE 1:Comparison Between KSA & USA Bidders (BID)

Factors	Rank	
	KSA	USA
Size of contract in SR	9	9
Location of project	12	6
Project cash flow	15	21
Owner	20	3
Type of equipment required	24	29
Job start time	34	26
Duration	36	23
Type of contract	1	–
Design quality	2	19
Designer (A/E)	13	–
Owner special requirements	32	–
Reliability of subcontractors	3	–
Availability of required cash	4	25
Availability of qualified staff	6	18
Establishing long relation with clients	8	–
Need for work	10	2
Uncertainty in cost estimate	14	17
Experience in such projects	16	–
Confidence in work force	19	16
Strength in industry	21	8
Public exposure	26	–
Current work load	27	13
Past profit in similar jobs	28	4
General (office) overhead	31	28
Portion subcontracted to others	37	24
Required bond capacity	11	–
Bidding document price	17	–
Competition	22	11
Time allowed for submitting bids	23	–
Time of bidding (season)	33	31
Prequalification requirements	35	–
Governmental division requirements	5	–
Risk involved in investment	7	12
Quality of available labor	18	–
Overall economy (availability of work)	25	10
Availability of equipment	29	–
Availability of labor	30	7

TABLE 2: Comparison Between KSA & USA Bidders (MARKUP)

Factors	Rank	
	KSA	USA
Duration	2	24
Type of equipment required	3	28
Size of contract in SR	6	14
Location of project	11	10
Job start time	18	29
Owner	32	9
Project cash flow	36	20
Type of contract	1	–
Design quality	5	13
Designer (A/E)	12	–
Owner special requirements	25	–
Uncertainty in cost estimate	4	4
Establishing long relation with clients	7	–
Reliability of subcontractors	8	12
Need for work	10	11
Current work load	14	6
Availability of required cash	15	25
Past profit in similar jobs	17	5
General (office) overhead	20	26
Strength in industry	22	19
Confidence in work force	23	17
Experience in such projects	24	–
Public exposure	26	–
Portion subcontracted to others	31	22
Availability of qualified staff	33	23
Required bond capacity	13	–
Time allowed for submitting bids	16	–
Bidding document price	19	–
Time of bidding (season)	29	30
Prequalification requirements	30	–
Competition	34	16
Risk involved in investment	9	7
Availability of equipment	21	–
Governmental division requirements	27	–
Quality of available labor	28	–
Overall economy (availability of work)	35	15
Availability of labor	37	18

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